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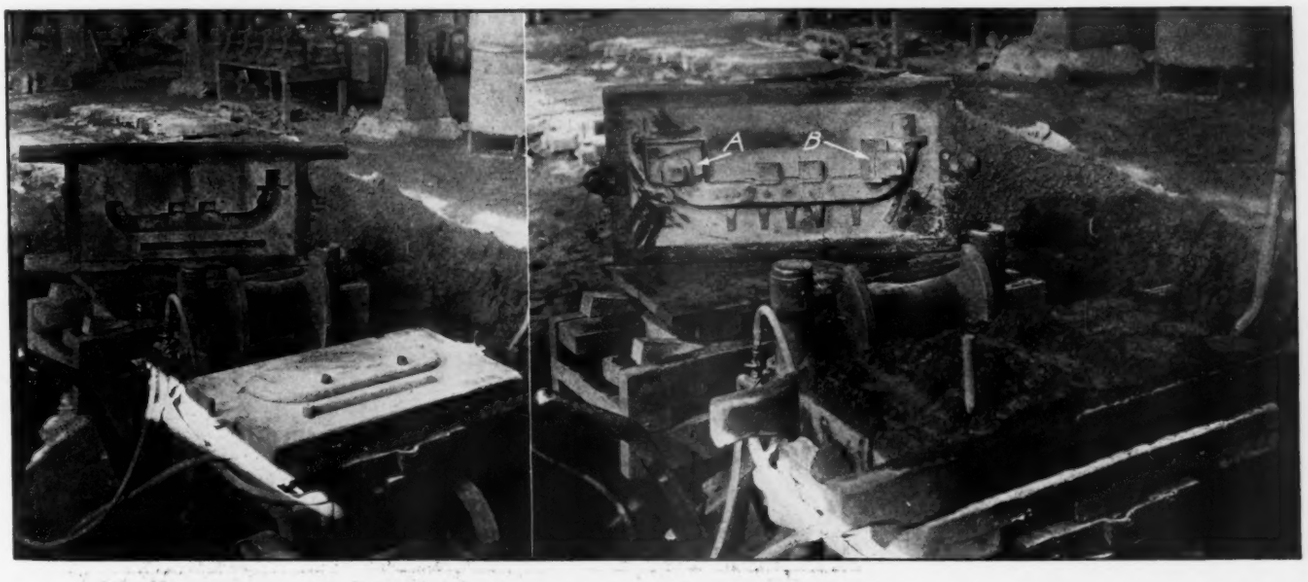
Demand Induces Change in Output

The Volume of Available Business in Recent Years Has Resulted in the Introduction of Special Equipment for the Production of Automobile and Gas Engine Castings on a Large Scale

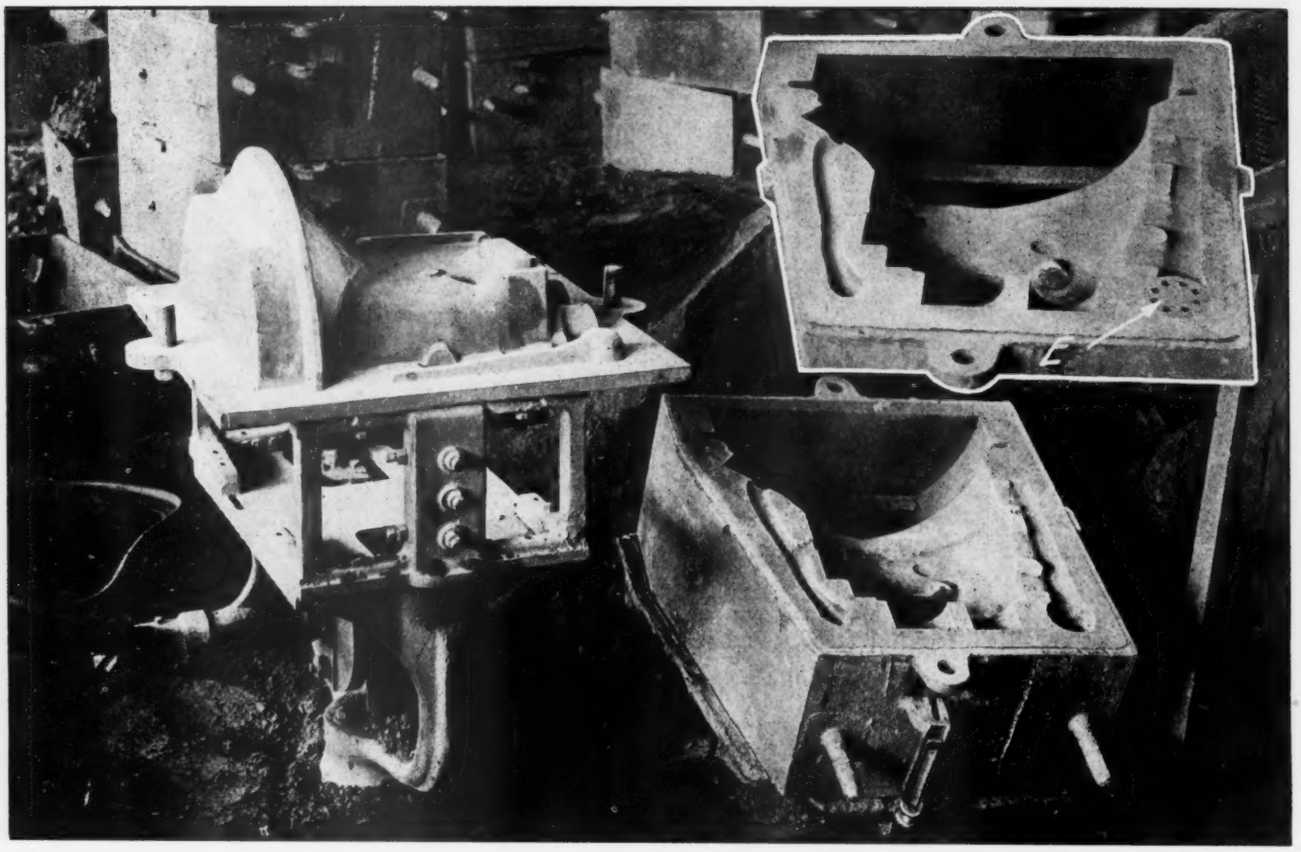
CONSIDERING the number of foundries engaged exclusively or in part in the manufacture of castings for automobiles, one is led to wonder what some of them found to do before the automobile was invented. Many large plants have been erected and equipped during recent years expressly for producing engines, transmissions and differential housings, gears, sprockets and other parts for automobiles, trucks and tractors of various types. Still other foundries have been engaged either in whole or in part in turning out castings for molds, presses or other tools used in the formation or finishing of the rubber, the sheet steel and forged parts which enter so largely into the construction of self-propelled vehicles.

The foundries that were built to handle this class of castings are equipped with the most complete and accurate mechanical devices to insure that the cores and different parts of the mold are assembled in their proper relative positions. This is essential, due to the exceedingly thin section of some castings produced. As far as possible the personal equation is minimized by having almost everything done mechanically. Patterns are mounted on machines, rammed and stripped according to an arbitrary standard which lessens the chance of errors on the part of the operator. Cores are dried in formers, which prevent distortion, assembled by the aid of jigs and gages and held in place by chaplets and anchors which are located definitely instead of being placed according to the individual judgment of the molder who is closing the mold. Foundries which were built to handle a general line of work and afterward switched to the automobile field, found it necessary to adopt the ideas and methods prevalent in the shops which had been designed exclusively for the production of automobile castings.

The Bay View Foundry Co., of Sandusky, O., in the past has made large quantities of automobile castings, as well as 1 and 2-cylinder engines for electric



FIGS. 1 AND 2—MANIFOLD PATTERNS ARE SPLIT ALONG THE CENTER LINE—EACH HALF IS ATTACHED TO AN INDIVIDUAL PATTERN BOARD BUT THEY ARE BOTH RAMMED ON ONE MACHINE—NOTE THE STYLE OF GATE, ALSO THE CORE PRINTS OVER THE DRAG FLANGES



FIGS. 3 AND 4—THE COPE AND DRAG HALVES OF THE PATTERN ARE MOUNTED ON INDIVIDUAL STRIPPING PLATE STANDS—THE GATE WITH STRAINER CORE IN PLACE IS SHOWN AT *E* FIG. 4

light plants, power boats, electrical devices and other high class work requiring extreme care in the making.

A few jar-ram machines are employed in the Sandusky plant, but the most of the molds are rammed by hand, either on plain stripping plate machines or on rollover, pattern-draw machines. Snap flask molds are made on pneumatic squeezers. A certain amount of work, short orders, odd pieces, etc., still is made in this shop on the floor in the ordinary way, the molds being rammed by hand and the patterns drawn in the same way. Both wood and iron flasks are used at the present time but the tendency steadily is toward the substitution of iron and steel flasks when renewal is necessary.

Examples of wooden flasks may be seen in the illustrations, Figs. 5 and 6. These molds are made on hand-ram pattern-draw roll-over machines supplied by the Tabor Mfg. Co., Philadelphia. The manifold pattern shown in Figs. 1 and 2 is split longitudinally and each half mounted on a separate board. The board containing the drag half of the pattern is mounted on the machine first and the required number of drags rammed and set down in a double row on the floor. The drag pattern board is then removed and replaced by the board carrying the cope half of the pattern when a sufficient number of copes are rammed to cover the drags. The molds shown in Fig. 8 are made in a similar manner. The lift over the two pockets in Fig. 2 is facilitated by attaching core prints at the two points indicated by *A* and *B* in Fig. 2. This arrangement gives a flat parting for both cope and drag. After the drag has been placed on the floor and the main core set, the stop off cores are dropped into the pockets at each end, thus simplifying what would otherwise be an upward lift at these points.

A striking commentary on the question "what is a day's work?" is furnished by the job illustrated in Figs. 9 and 10. This is a small transmission housing weighing about 50 pounds, molded in a flask 20 x 20 inches, cope and drag each being 10 inches deep. The pattern is split in the center and each half is mounted on a mold board as shown. The drag board is placed on the machine first and a certain number of drags are rammed. It then is

FIG. 5—A FLOOR OF MANIFOLDS CORED READY FOR THE COPES—THE STOP OFF CORES *K* ELIMINATE A DEEP LIFT AND MAKE A STRAIGHT PARTING POSSIBLE

FIG. 6—LONG STEM CHAPLETS ARE EMPLOYED FOR HOLDING DOWN THE JACKET CORES—THE UPPER END OF THE CHAPLET IS WEDGED UNDER THE BAR

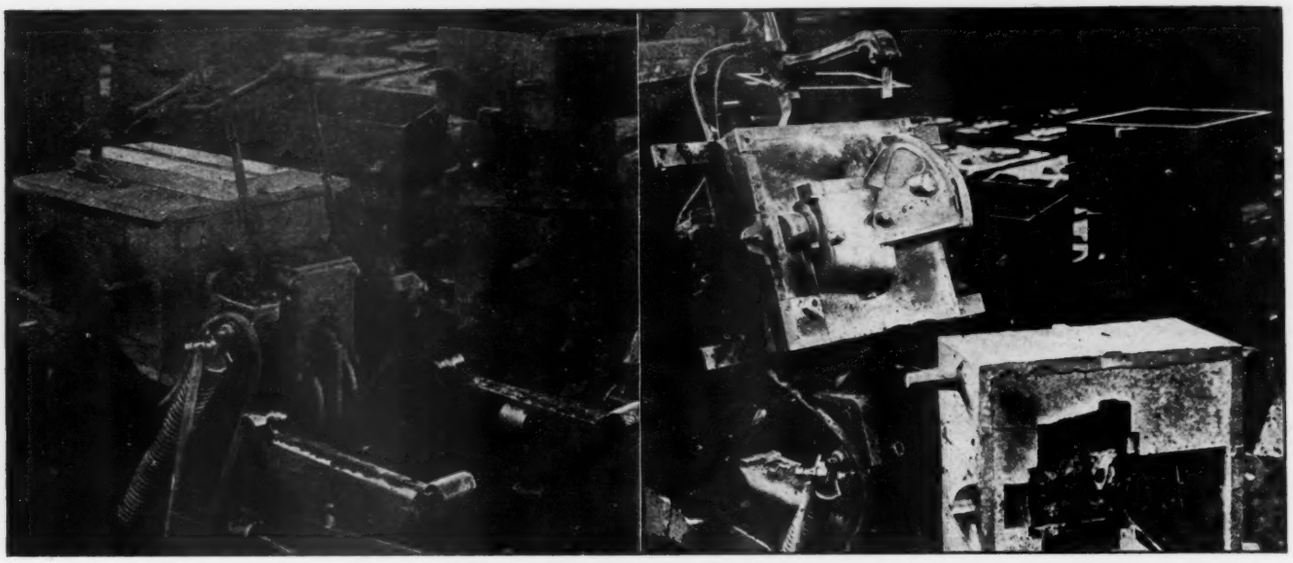
taken off and the cope board is used until a sufficient number of copes have been rammed to cover the drags. A rollover pattern-draw machine is employed but the molds are rammed by hand and this is the principal feature on which opinions differ. When the mold is rammed with a nice sense of discrimination, as it is by some molders, the pattern will draw perfectly and no hand finishing is necessary. However, when the mold is rammed by men who have not this peculiar knack it will be more or less of a wreck and either will have to be shaken out or will require much patching. After painstaking efforts on the part of the management, this type of molding gradually has been perfected and has resulted in the development of a large number of first class operators.

As a precaution to prevent dirt from entering the mold, various types of skim gates are employed, depending upon the size and general characteristics of the casting. Strainer cores, similar to that shown at *E*, Fig. 4, are inserted at predetermined points in the runner to accomplish the desired purpose. Sometimes these are located in the pouring basin, occasionally at the bottom of the sprue, and again near the end of the gate just before it enters the mold. It may be noted that the runner on the manifold, Figs. 1 and 2, is modeled on the old fashioned *storge* gate; that is the runner is in the cope and the jets or branches are in the drag. This type gate is designed to catch and hold without the aid of a strainer core, any dirt which may enter the main runner.

FIG. 8—WOODEN FLASKS STILL ARE USED TO A CERTAIN EXTENT IN MAKING THE CLASS OF CASTING SHOWN ABOVE

FIG. 7—THESE CORES ARE NOT PASTED AND WIRED TOGETHER BEFORE GOING IN THE MOLD—ONE HALF IS SET IN THE DRAG AND THE OTHER HALF SET ON AFTERWARD

The pattern for the transmission housing shown in Figs. 3 and 4 is symmetrical and each half is mounted on a separate machine. The machines are plain stationary tables which act as stripping plates. The molds are rammed by hand after which the patterns are drawn pneumatically. Two men are employed on this particular pattern, one making copes and the other making drags. Part of a floor of molds is shown in Fig. 7. It may be seen from this illustration that the core also is made in halves and set in the mold one half at a time. After the cores are dried they are assembled on benches provided for that purpose, rubbed to a bearing and carefully calipered to the correct size. They then are taken to the molding floor and distributed, two



FIGS. 9 AND 10—THESE MOLDS ARE RAMMED BY HAND ON A ROLLOVER PATTERN-DRAW MACHINE—ONE MOLDER PUTS UP 60 MOLDS A DAY

halves to each flask. After the bottom half of the core is set, a little paste is laid on the joint close to the edge all around and then the other half of the core is set on. The top half is located in its correct relative position by observing that the boundry lines on the joint of each half coincide throughout their length.

One oven situated at one side of the main bay of the foundry at one end still is used for drying some of the cores. It is equipped with shelves along both sides, as well as with a car supporting several decks. It was once the only oven and sufficed to dry all the cores that were necessary, but now it only forms about 15 per cent of the core-drying capacity of the plant. A modern, up-to-date core room was erected and equipped some time ago to take care of the company's requirements in this respect. The latter covers a space approximately 75 x 100 feet, is constructed of brick and steel and is provided with ample lighting and ventilating facilities.

The end of the coreroom fronting on the railroad spur is provided with a number of concrete bins into which the sand is unloaded directly from the cars. Sandusky and Michigan City sharp sands, mixed in varying proportions, are used for making the cores. The sand is mixed in two revolving paddle type mixers made by the Blystone Mfg. Co., Cambridge Springs, Pa. Several mixtures are employed depending on the nature of the work in hand; but as a rule the sand requiring a liquid binder is mixed in one of the machines and that in which a dry binder is employed is mixed in the other. No attempt is made to salvage any of the old or burnt sand as the cores are made entirely of new sand. The floor of the core room is covered with a smooth coating of concrete and this renders it comparatively easy to keep it clean.

Many of the cores are small and are made by hand on the bench in the usual way. However, eight rollover, pattern-draw machines, made by the E. J. Woodison Co., Detroit, are employed, and for the deep cores, two roll-over, pattern-draw machines provided with a counter weight attachment are used. These were made by the International Molding Machine Co., Chicago. The cores having flat surfaces are dried on plates, but those of irregular or special shape are dried in formers composed of sand and oil. To make these formers a half core first is made and dried. This then is placed on a flat plate and surrounded by a shallow frame. This frame is rammed full of a strong oil sand mixture well reinforced by rods or wire. The frame containing the sand is covered by a plate and the whole assembly is rolled over. The half core is removed and also the frame after which the block of sand with the impression of the half core is placed in the oven and dried. A number of these driers always are kept on hand and it is stated that they may be used 40 or 50 times before their usefulness becomes impaired.

Four cars are provided for convey-

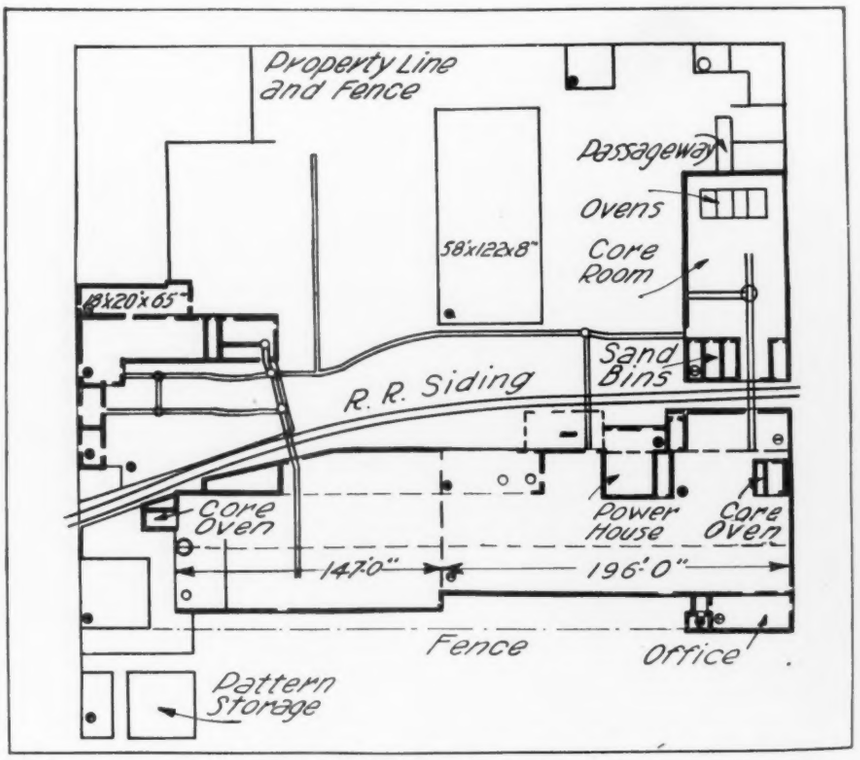


FIG. 11—GROUND PLAN SHOWING THE LOCATION AND RELATIVE POSITION OF THE VARIOUS UNITS COMPRISING THE PLANT

ing the cores into the ovens. As may be seen by referring to the illustration, Fig. 12, they are lightly but strongly built and each is provided with six decks. The longitudinal strips on the car are made of angle irons, a feature which insures a maximum contact of the heated air in the ovens with the bottom of the plates. The cores are dried in a battery of four ovens made by the Ohio Body & Blower Co., Cleveland. Each oven is 7 x 7 x 8 feet and is coke fired. Four drawer type ovens fired by gas, made by the same company, also are employed.

Each of the large ovens is provided with a track to accommodate a car and also with a number of standards having graduated steps on which long pieces of pipe may be placed at any height to support the core plates. In this way the oven may be utilized for drying cores even if the car is not available or if the cores are too bulky to go on the car. Each oven is heated individually. The fire boxes are in a common pit at one end of the battery and the heated currents pass through a chamber under the floor entering the oven through a series of ports provided for that purpose. A large hood suspended over the door of each oven serves to carry off the fumes and heat when the door is opened.

To facilitate moving carloads of cores from the core room to the foundry, a turn-table is provided at the junction of two branches of a narrow gage track. One branch track leads to the assembling room where the cores are tried by gage and templet. The other track extends across the yard and enters the foundry at a point nearly 300 feet distant.

A depressed track extends across the front of the four car ovens. A special underslung-body transfer car operates on this track and serves to change the cars from one oven to the other if necessary. The lock and catch shown at *L* and *M*, Fig. 12, are employed to bring the tracks on the car in line with any given set of tracks on the floor. With this outfit there is no waiting either for cars or for ovens. The cars may be shifted from one track to the other or from one oven to the other with the greatest facility.

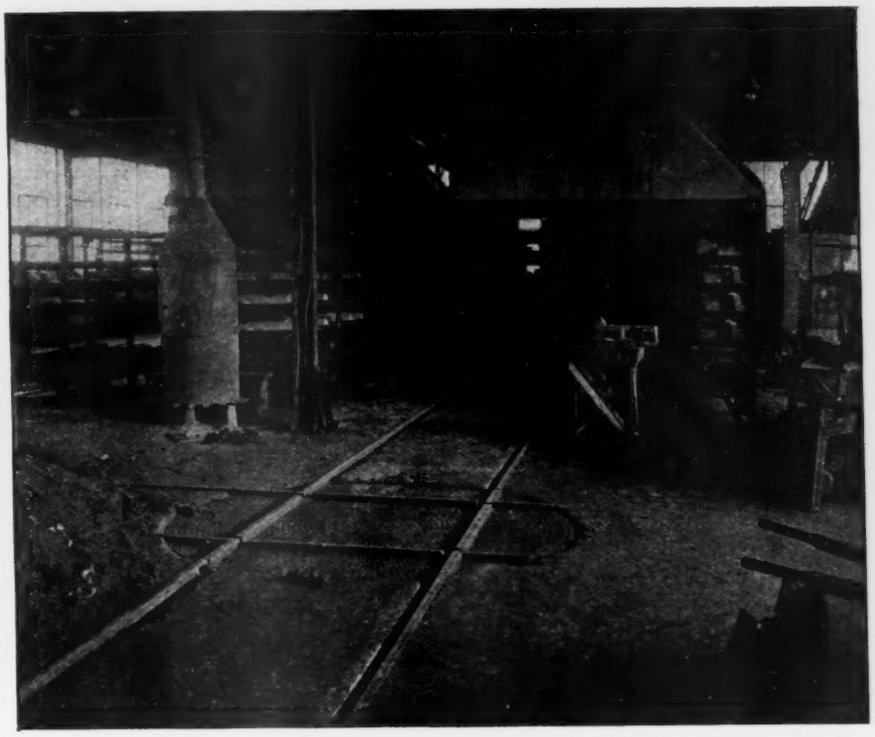


FIG. 13—A TURNTABLE IN THE CENTER OF THE COREROOM FACILITATES THE HANDLING OF CORES AND OTHER MATERIALS

A large floor upstairs over the assembling room has been equipped with classified and numbered racks and shelves to hold the immense stock of cores which always is maintained so that there will be no delay in production. A large, specially-designed, spring wheelbarrow is used for distributing a great number of the cores to the different floors in the foundry where they are needed.

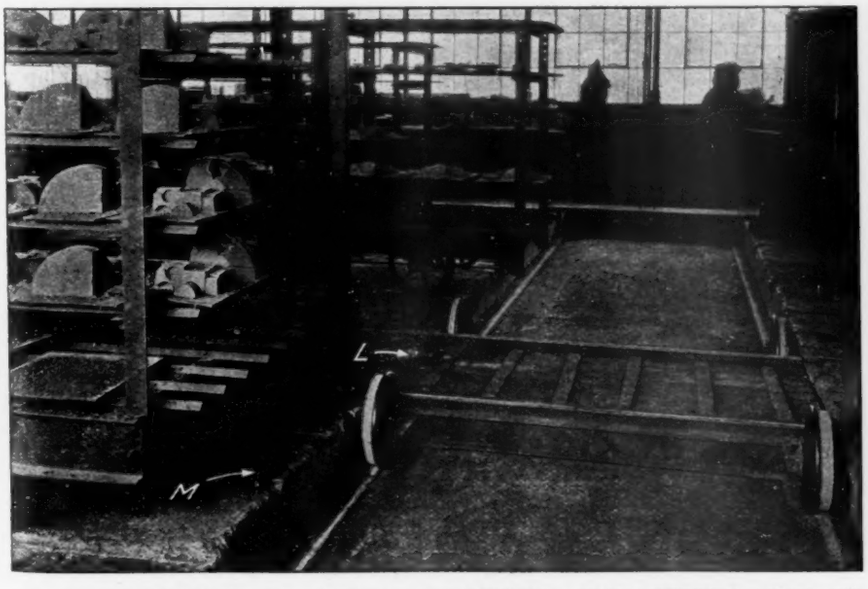


FIG. 12—THE UNDERSLUNG CAR OPERATES ON A DEPRESSED TRACK EXTENDING ACROSS THE FRONT OF THE FOUR OVENS

The foundry has a capacity of about 25 tons a day and metal is supplied by a cupola lined to 42 inches, made by the Northern Engineering Works, Detroit. The bed charge of coke is ignited by an oil torch introduced at an opening provided for that purpose at the back of the furnace and on a level with the sand bed. After the coke bed has burned through, the torch is removed and the opening bricked up. The iron and scrap charges weigh 1700 pounds each.

Several varieties of northern and southern irons are used, including about 10 per cent charcoal iron. The coke between the charges is not weighed but measured, eight forkfulls of coke yield satisfactory iron, hot enough to run any casting on the floor.

The blast for melting the iron is provided by a fan made by the Buffalo Forge Co., Buffalo. The blower is situated in an adjoining building which also houses the other power units, including two vertical gas engines, 140 and 50 horsepower respectively, made by the Lazier Gas Engine Co., Buffalo; two direct current generator sets, 110-120 volts, one supplied by the Westinghouse Electric Co., the other by the Allis-Chalmers Co., Milwaukee; and two belt-driven compressors, one made by the Ingersoll-Rand Co., and the other built by the Bury Mfg. Co., Erie, Pa.

The foundry building, 80 x 356 feet, is divided into three bays and contrary to the layout in many foundries it is practically all molding floor. The center bay is spanned by two electric traveling cranes made by the Northern Engineering Works, Detroit, one of 10 tons and the other 5 tons capacity. The foundry office is attached to one corner of the foundry building and has a door opening directly onto the molding floor.

A. W. Link, who retired as president on April 1 this year, together with two associates, organized the Bay View Foundry Co. in 1904 with $10,000 capital. The company first rented a building covering approximately 4000 square feet, but the business grew so rapidly that it was considered advisable to increase the capital and erect a suitable building. E. L. Marsh and four other men subscribed further capital in 1907, increasing the total to $40,000. Mr. Marsh was elected vice president and treasurer, a position he held until the retirement of Mr. Link, when he was elected president of the company. The capital has been increased twice since 1907, it now stands at $300,000.

From five to ten men were employed regularly during the first few months this number had increased to 25 by the end of the year. At the end of 10 years there were practically 100 men in the employ of the company and at the present time there are approximately 225.

The first unit of the present plant was built in 1908. It covered approximately 12,000 square feet. Subsequent additions have brought it to its present size covering an area of about 70,000 square feet.

Some time ago the company installed a small converter and cupola and now is prepared to handle small and medium size steel castings in addition to gray iron and brass.

As necessary adjuncts to a complete plant, a well equipped pattern shop is maintained, capable of producing patterns of all descriptions either in wood or metal. A machine shop provided with all the necessary machinery for finishing small castings makes it possible for the company to perform every step in the process from the blue print to the assembled castings. The machine shop is relatively small compared to the foundry as most castings are shipped rough.

Handling Rush Work in English Shops

BY JAMES PEARSON

FOUNDRYMEN generally, at least those whose experience dates back 20 years or more are fairly familiar with the shop conditions touched upon by Pat Dwyer in a recent issue of THE FOUNDRY. He says, among other things, that the wind would not be put on until every mold was ready, until the last bolt was tightened and the last iittle bali of clay placed in the riser. That was fairly common practice at that time and for that matter is yet to a certain extent. However there are exceptions to the rule now and there were exceptions to the rule occasionally in those days. I remember at one time of putting on the wind to melt the iron for a job before the pattern came into the foundry. That statement may appear far fetched but it is the absolute truth.

I was foundry foreman at an engineering plant in England and at night played a violin in the theater orchestra where it was necessary that I take my place at 7:20 p. m. One day just as I had all the molds poured off and was about finished work for the day, the head of the firm rushed into the foundry and informed me that an engine crank had broken at a colliery and he wanted a new one cast as soon as possible. I instructed the cupola man to let the cupola stand until I came back and then went to look at the pattern. I found it to be for a casting which would weigh about 1500 pounds. I instructed the cupola tender to charge the necessary amount of iron and put on the wind at once. About 5 minutes after the wind was on, or at 5:15 p. m. the pattern was brought into the foundry and at 6:30 the metal was in the ladle ready for the job which we were at that time engaged in blacking.

The crank was poured at 6:45 and having left two men to feed it, I rushed home, consuming about 20 minutes in the journey, and 15 minutes later was in my place in the orchestra.

The work in the foundry consisted of hauling, pumping and winding engines principally for colliery work, but we also made propellers for canal boats. The rig for making these wheels comprised a round iron ball, three individual blades, a spindle, seat and a templet. The ball or hub was provided with three holes equally spaced to locate the pins on the ends of the blades.

In making a propeller with this rig, the spindle seat and spindle first were set up. Then a collar was slipped over the spindle and located at a definite point on the spindle with a set screw. The hub was then dropped down until it rested on the collar after which one of the blades was set in position by inserting the pin on the end of the blade into the hole in the hub provided for that purpose. A templet, attached to an arm swinging on the spindle and conforming closely to the contour of the cope side of the blade, was used to hold the blade to the proper angle, or pitch, while ramming the under side. Each of the three blades was treated in a similar manner and when the third parting was made, a cope large enough to cover the complete mold was lowered into place and rammed full of sand.

We made quite a number of these castings and the rig was considered satisfactory until an incident arose which caused me to change my mind and which resulted in getting two castings a day where we formerly only could get one. The rig for making these small 3-foot diameter propellers was in use some time before I was engaged as foundry foreman and one casting per day was considered a days work for a molder. A man could easily finish the mold an hour before quitting time and shortly after I had taken charge I had occasion to ask the man after he had closed the wheel to make two small open sand plates for a pipe core. He refused on the ground that the propeller was a days work. I told him I intended to get two a day in future. The next casting that was made I had finished up in good style for a pattern and afterward had no trouble in getting two castings a day.

Increases Capital Stock

The capital stock of the Werner G. Smith Co., Cleveland, makers of core binders, has been increased to $750,000 to provide for new buildings and improved manufacturing appliances. The increase is made in common stock, from $100,000 to $700,000, while the preferred

Will Make New Line

The Worthington Pump and Machinery Corp., 115 Broadway, New York City, which has manufactured hydraulic machinery since 1840, recently has completed preparations to produce water power machinery including turbines and auxiliary equipment.

The R. Herschel Mfg. Co., Peoria, Ill., has awarded a contract for the construction of a new gray iron and malleable foundry, 127 x 284 feet. C. C. Peterson is foundry manager.

German Foundries Must Conserve

Shortage of Raw Materials, High Prices and Labor Inefficiency Have Combined to Force Adoption of Mechanical Methods—An Inside View of Technical Conditions in German Foundries at Present

BY HUBERT HERMANNS

WE CAN learn even from those who recently were our enemies—in fact it can be said we should learn specially from our enemies. Therefore THE FOUNDRY *feels every assurance in presenting this article which gives an accurate inside view of recent technical progress in the German castings industry. Written strictly from the technical standpoint for the purpose of conveying information regarding practice and methods, this article contains facts with which every foundryman should be acquainted. Special attention is called to the interesting details presented covering cupola-charging apparatus of the skip-hoist type, automatic overhead trolley systems, and slag reclamation plants.* THE FOUNDRY *offers this article as the only authoritative review of German foundry practice from the technical standpoint which has been printed west of the Rhine for over six years. Our readers thus are given unique service which only* THE FOUNDRY *is able to render through its specially organized European division, which procured, translated, and edited this article. The author, Hubert Hermanns, is a prominent German foundry engineer residing in Berlin.*

WHEN the war broke out the foundries in Germany found themselves confronted by problems to cope with which they were not properly organized. Large increases in production were necessary in certain directions, particularly in the steel casting field, and it is well known that before the war the majority of German foundries were not prepared for quantity production in the same manner or to the same extent as many of the casting plants in the United States. A large number of the foundries in Germany, in fact, are small establishments which cannot readily be arranged for quantity production. Soon after the war started, the German foundries found themselves hampered in unexpected directions. For instance, certain raw materials, such as English pig iron, to the use of which their practice had been adapted, suddenly became unobtainable and German materials had to be substituted. Among the steel foundries the scarcity of manganese soon became acute. In all sections of the German foundry industry the coke showed an increasing percentage of sulphur and ash as the war went on. Furthermore, during the latter years of the conflict, pig iron became so scarce that the melters were compelled to use large quantities of scrap of indifferent quality. This, together with the fact that the only pig iron which could be obtained was low in silicon, the usual range being 1 to 1.50 per cent, multiplied the difficulties which had to be confronted. This combination of causes brought about a continual increase in the percentage of sulphur in the castings and in 1918 the castings usually contained from 0.15 to 0.20 per cent sulphur. On account of the low silicon in the pig iron the castings

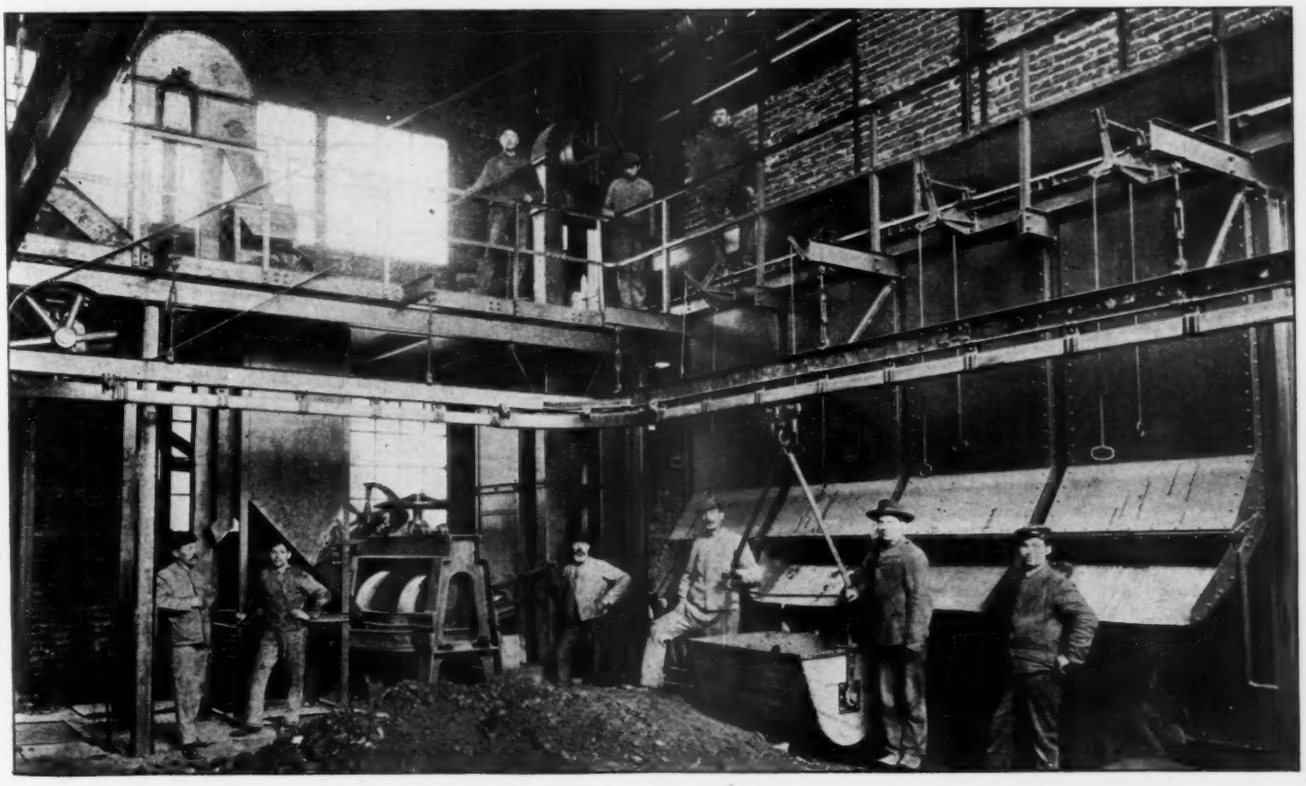


FIG. 1—A SMALL GERMAN PLANT WITH A CAPACITY OF 210 TO 280 CUBIC FEET PER HOUR FOR MILLING, TEMPERING AND DRESSING SAND

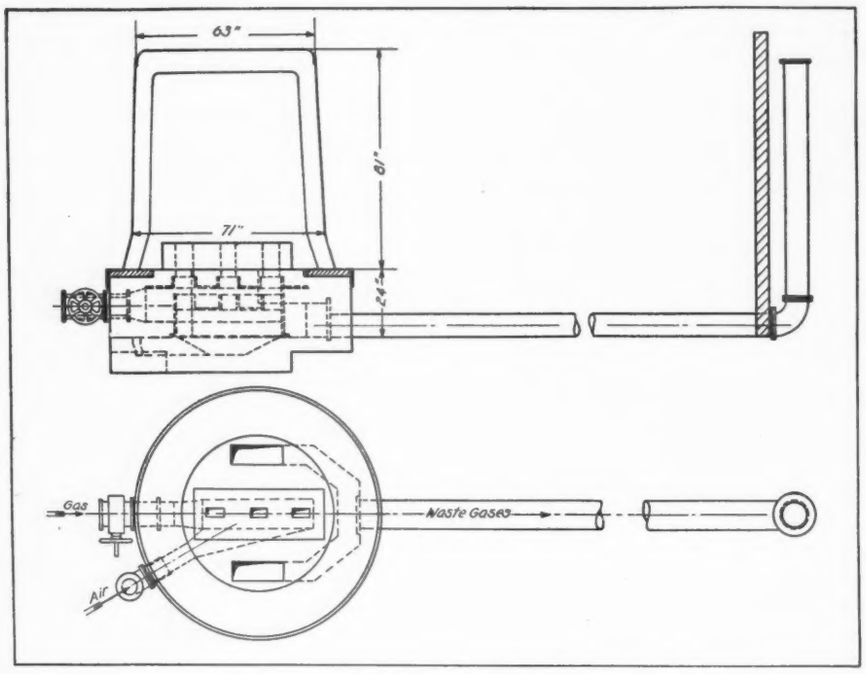


FIG. 2—GAS-FIRED LADLE DRYER

frequently were extremely hard. They also exhibited a tendency to alter their shape and to develop internal strains. The proportion of silicon in the scrap also decreased continually during the war. The only remedy for these difficulties was to use as much high-silicon pig iron—silvery iron—as could be obtained. In short, the German foundries had to make the best of a bad job during the war. These unfavorable conditions still persist to a large degree. Those shops which were provided with their own laboratories did not suffer from these difficulties as much as the great majority of smaller plants in which rule-of-thumb methods were followed.

Although the metallurgical difficulties were only partly overcome, considerable progress was made in other directions through the introduction of labor-saving equipment. The war turned out to be a great stimulus to the installation of labor-saving machinery in German foundries. Nearly all of the able bodied men were called to the colors by the military authorities and therefore it was imperative to replace their efforts and at the same time to increase production to meet war demands. The labor shortage was partly relieved by the employment of women to a degree which had hitherto been considered impossible in foundries. This, in turn, however, necessitated the simplification of the work in such a way as to enable women to satisfy the requirements. As a result, the use of molding machines was very largely increased.

Still it has to be admitted that important improvements in German molding-machine design and methods of operation were not realized during the war. On account of the tremendous demand for output, machines and methods which had been tried before and were therefore dependable, had to be employed. As a matter of fact, there was not time available for carrying out experiments. Nevertheless the experiences which German foundrymen passed through from 1914

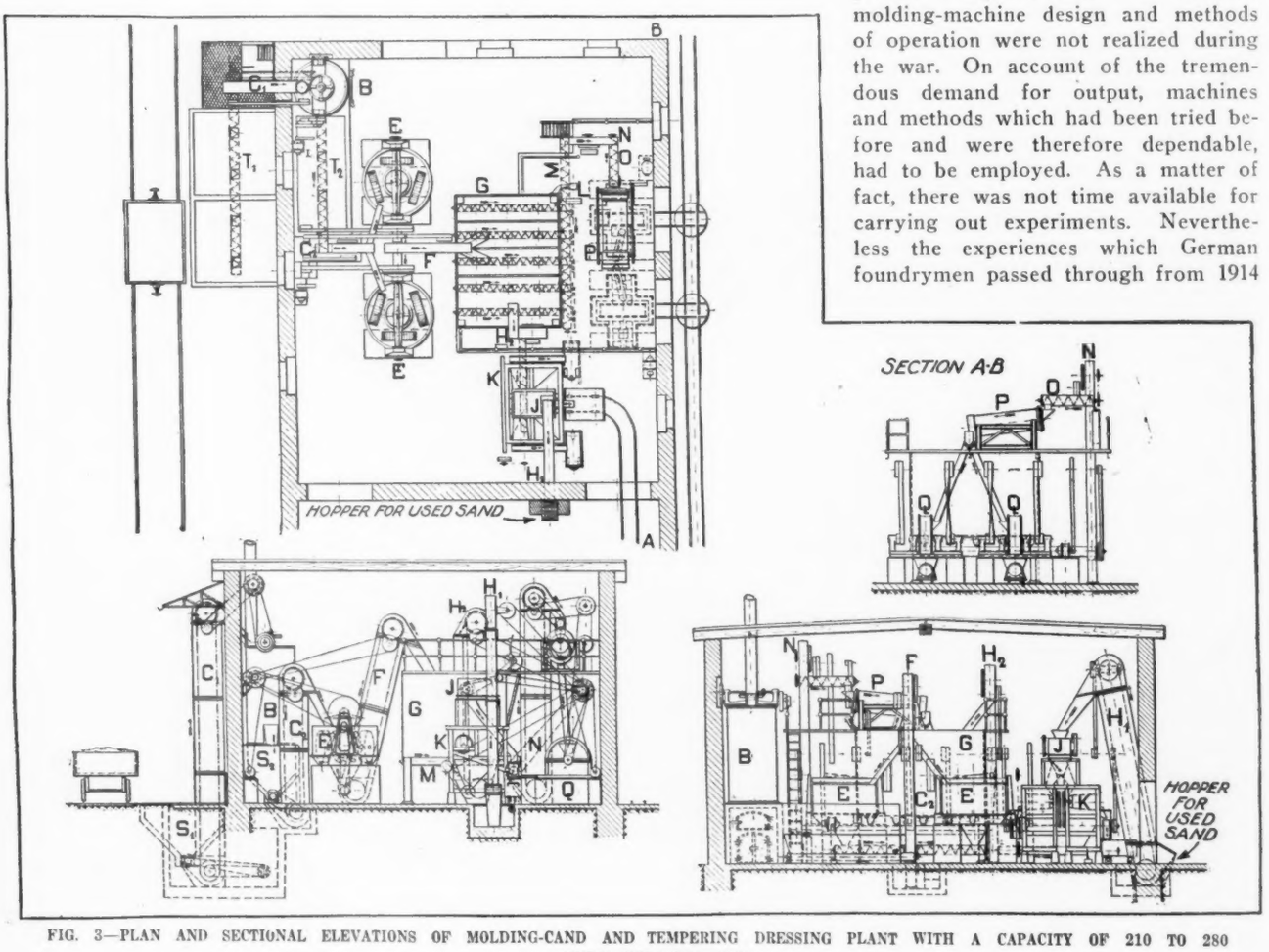


FIG. 3—PLAN AND SECTIONAL ELEVATIONS OF MOLDING-CAND AND TEMPERING DRESSING PLANT WITH A CAPACITY OF 210 TO 280 CUBIC FEET PER HOUR

to 1919 taught them a great deal about the effective use of molding machines and there can be no doubt that German foundry work will benefit by this experience in the future.

Like other belligerents, Germany was compelled to make a special effort to increase the production of steel castings and it was the electric furnace process that benefited most from this development. Electric-furnace design has shown considerable improvement in Germany since the war. Two types of arc furnaces, the direct and the indirect, as well as induction furnaces, now have been thoroughly tested. These types probably will remain in service under peace conditions. The output of steel castings in Germany in 1913 was 357,109 tons. This was increased to 1,471,042 tons in 1917, according to figures presented with the general article on German foundry conditions published in the April 15 issue of THE FOUNDRY. Figures on the production of electric steel castings in Germany show that they increased 19,536 tons in 1908 to 219,700 tons in 1917. Before the war there were about 20 establishments in Germany using electric furnaces; during the war the number of establishments employing this method of melting was doubled. The electric furnaces built in Germany during the war have an average capacity of 6.07 metric tons each.

Three of the main objects of German foundrymen throughout the war and also during the past 1½ years have been to develop more efficient methods of burning coke, to save fuel by the conservation of heat, and to utilize waste products. In the opinion of the author some noteworthy advances have been achieved along this line.

Many Oil-Fired Furnaces

Most of the steel foundries in Germany using open-hearth furnaces can be kept going at present only during the day time. This was also true during the war and, therefore, the use of oil-fired open-hearth furnaces has greatly increased. Tar oil, which is obtained from coking plants, is the fuel usually employed. This change to oil fuel has been stimulated by the shortage of coal and the necessity for utilizing all possible sources of heat. In the German oil-fired open-hearth furnaces burning tar oil, the average time from the beginning of the heat to the moment of tapping is three hours. These oil-fired furnaces are said to produce an unusually good quality of steel. The fuel cost is about the same as with furnaces fired with producer gas but there is a saving in wages and in capital outlay and the total cost per ton is therefore usually less with the tar oil-

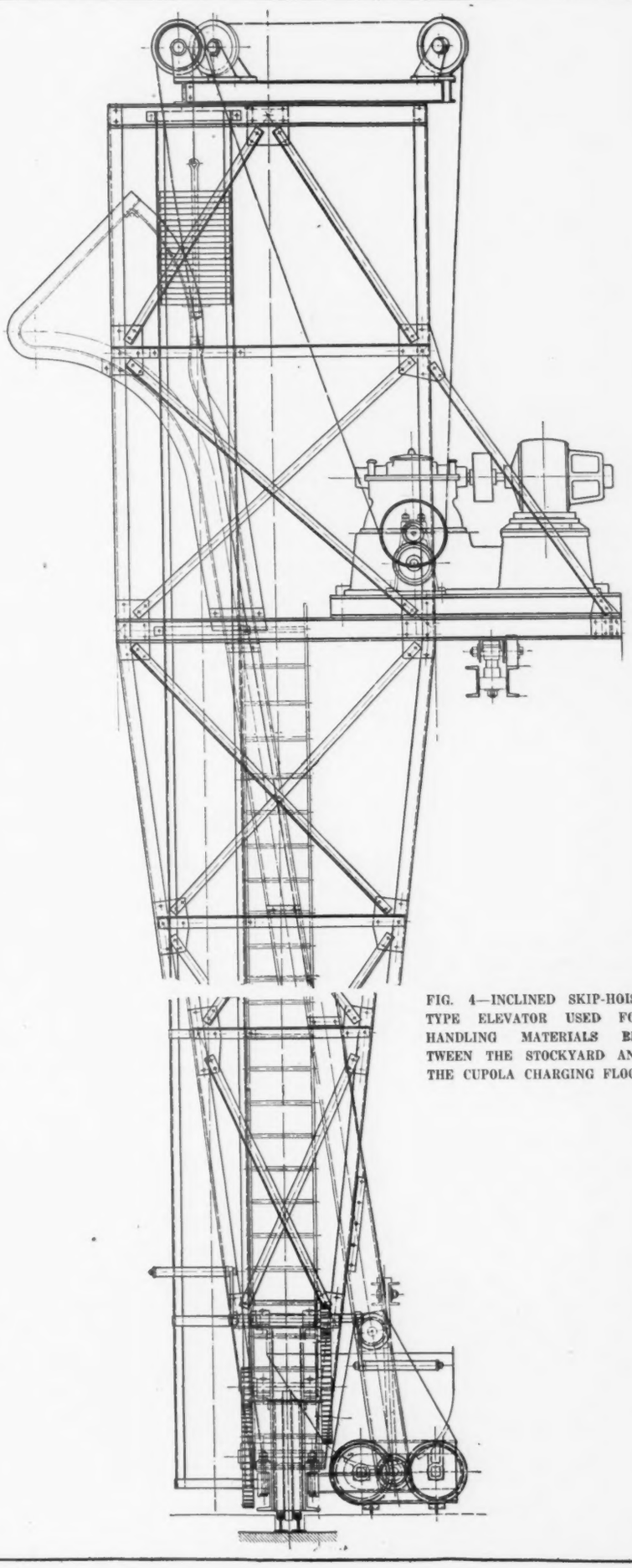


FIG. 4—INCLINED SKIP-HOIST TYPE ELEVATOR USED FOR HANDLING MATERIALS BETWEEN THE STOCKYARD AND THE CUPOLA CHARGING FLOOR

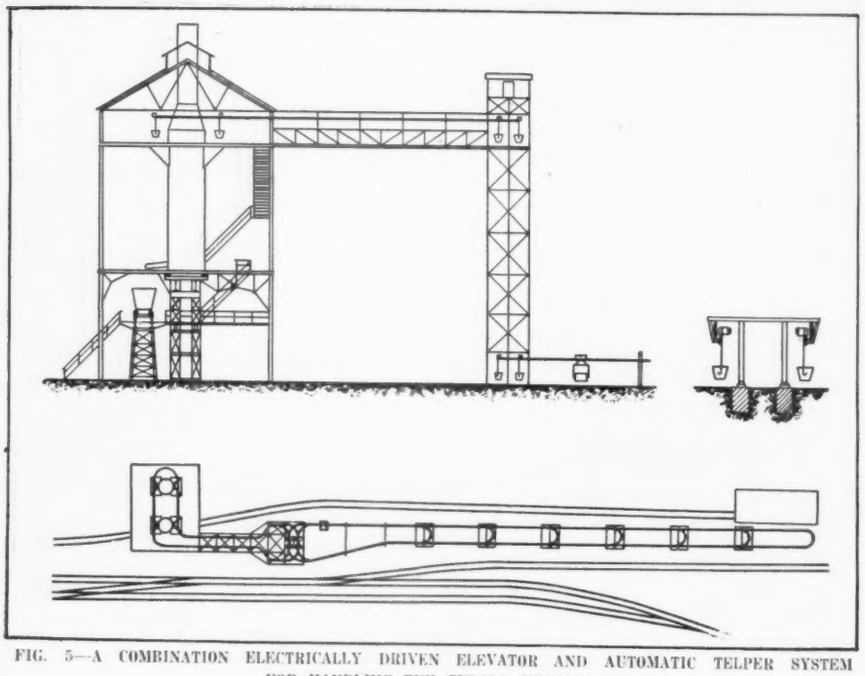


FIG. 5—A COMBINATION ELECTRICALLY DRIVEN ELEVATOR AND AUTOMATIC TELPER SYSTEM FOR HANDLING THE CUPOLA CHARGES

fired furnaces than with gas fired units.

In the converter foundries, a large number of multistage motor-driven turbo-blowers have been installed. Fig. 10 shows a modern turbo-blower of German design and construction built for this purpose. This size of blower contains eight rotors connected in series, the casting being split horizontally in the usual manner. It is unnecessary to provide facilities for cooling the blower, owing to the low pressure at which it operates. These blowers, it has been ascertained by tests, develop their highest efficiency at 2175 revolutions per minute. At this speed the efficiency is said to be 80 per cent. It is also said that the efficiency is not seriously affected by wide changes in load and that the blowers are flexible as regards volume of air delivered.

Use of Briquetted Borings

Briquetted borings are now being extensively employed in German foundries as a substitute for pig iron and ordinary scrap. Some progress had been made in the use of this material before the war. As a result of wartime experience both in the manufacture and melting of the briquettes it is stated that the castings turned out are usually equal in quality to those made entirely from expensive pig iron and high grade scrap mixtures. In the earlier days, difficulties were encountered in machining castings made from mixtures containing compressed borings, but this trouble has now largely been overcome, in the opinion of the author. The use of briquetted borings has also been found to provide a suitable means for preventing sponginess in castings at points where abrupt changes in section militate against proper solidification. The briquettes, however, must be used properly in the cupola and the peculiarities of briquetted iron have to be taken into consideration. If too large a proportion of briquettes is employed, the castings will be too hard owing to the excessive reduction of graphite and silicon. The following table gives mixtures containing borings which have proved satisfactory both for machinery castings and ordinary castings:

	Machinery Castings Per Cent	Ordinary Castings Per Cent
Hematite pig iron	10	15
German No. 3 foundry pig iron	20	..
Luxembourg No. 3 foundry pig iron	..	35
Special pig iron low in carbon	15	..
Cast scrap	30	45
Briquetted iron borings	15	5
Briquetted steel turnings	10	..

Machinery castings made from the foregoing mixture should contain 1.03 per cent silicon; 0.4 per cent phosphorus; 0.8 per cent manganese; and 0.08 per cent sulphur, and show a tensile strength of 35,400 to 39,800 pounds per square inch. The ordinary castings made from the foregoing mixture should contain 2 per cent silicon; 1.2 per cent phosphorus; 0.5 per cent manganese; and 0.13 per cent sulphur, and have a ten-

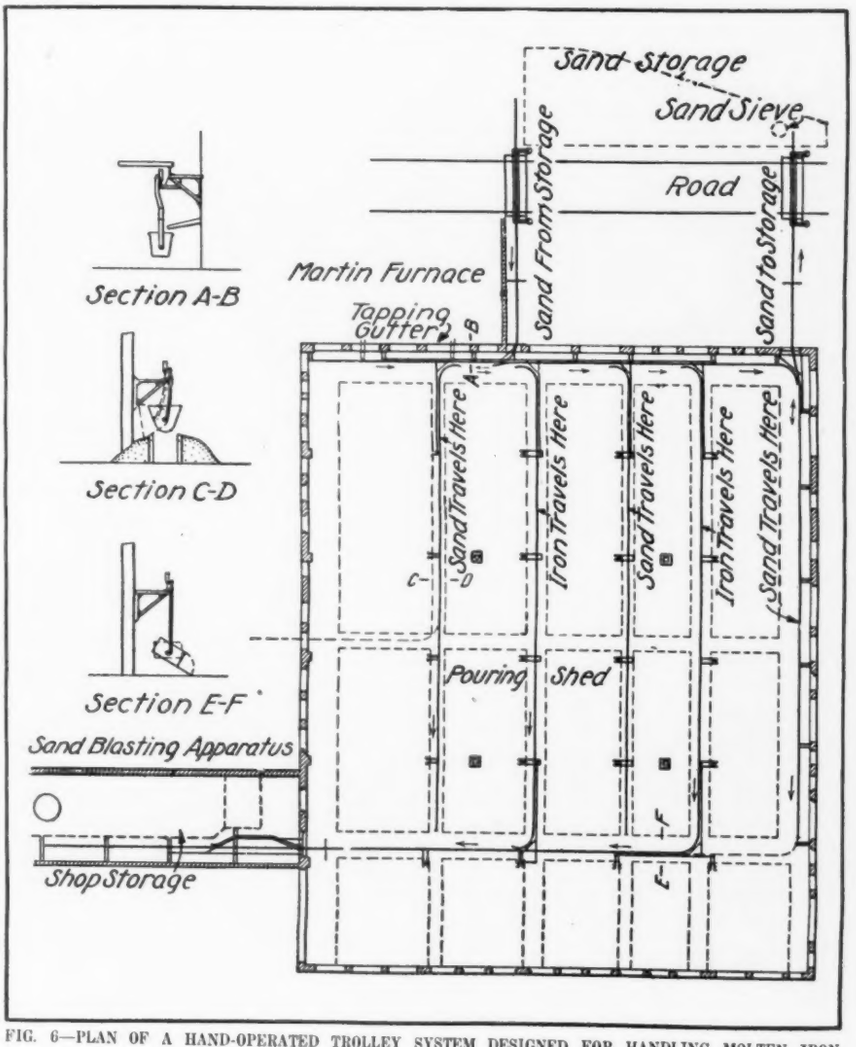


FIG. 6—PLAN OF A HAND-OPERATED TROLLEY SYSTEM DESIGNED FOR HANDLING MOLTEN IRON, CASTINGS, AND SAND

sile strength of 19,750 pounds to 24,100 pounds per square inch.

In many foundries wasteful methods of drying and heating the pouring ladles are employed. An arrangement devised in Germany during the war to save heat used in this operation is illustrated in Fig. 2. In the device illustrated in Fig. 2, the gas and air is conveyed to the mixing chamber in separate pipes. A triple Bunsen burner is employed. The waste gases of combustion are drawn off through two openings and in some plants are utilized for heating core ovens.

Elaborate Sand-Handling Plants

Considerable progress has also been made in Germany recently in the development of sand-handling and dressing apparatus. The design and arrangement of a mechanical sand-handling plant depends mainly on local conditions such as the size of the available space, the nature of the sand used, and the kind of castings to be turned out. In many cases even in many large foundries a few suitable self-contained devices are all that are required. However, when conditions call for a mechanical sand-handling plant, recent experience indicates that the apparatus should be designed to combine a large output of sand with minimum floor space, low first cost, and moderate repair and operating charges. Fig. 3 shows a general arrangement of a recently constructed large German plant for preparing and tempering foundry sand. The raw sand is brought into the foundry on railroad cars from which it is dumped into the floor bins S_1. A screw conveyor T_1, which extends under these bins delivers the sand to the boot of the vertical elevator C_1, from which it is in turn discharged into the vertical drying oven B. The dryer delivers the sand to the screw conveyor T_2, which is connected to the vertical elevator C_2. The latter discharges the sand into the two mullers E. After passing through these devices the sand is again raised by the elevator F and discharged into the mixing tank G. At this point the used sand is introduced. It arrives by means of the elevator H_1 which delivers it first to the magnetic separator J and thence to the revolving screen K. From the screen, the sifted sand is picked up by the elevator H_2 and discharged into the mixing tank. The latter is divided into several sections under each of which a screw conveyor is installed. These conveyors in turn deliver the mixed sand to the large screw conveyor M from which a connection is effected by means of the elevator N and the feed screw O with the cylindrical moistening and mixing drum P. The latter discharges the wetted sand into the two centrifugal disintegrators Q. After leaving the disintegrators the sand is fully prepared and ready for distribution throughout the foundry. Small cars operating on

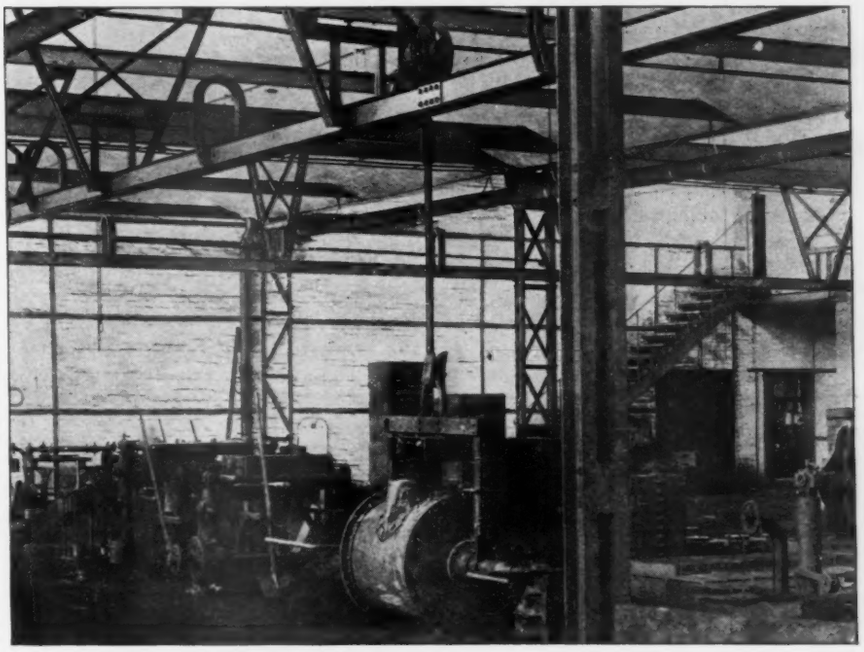


FIG. 8—A CHEAP TROLLEY SYSTEM OPERATED BY HAND

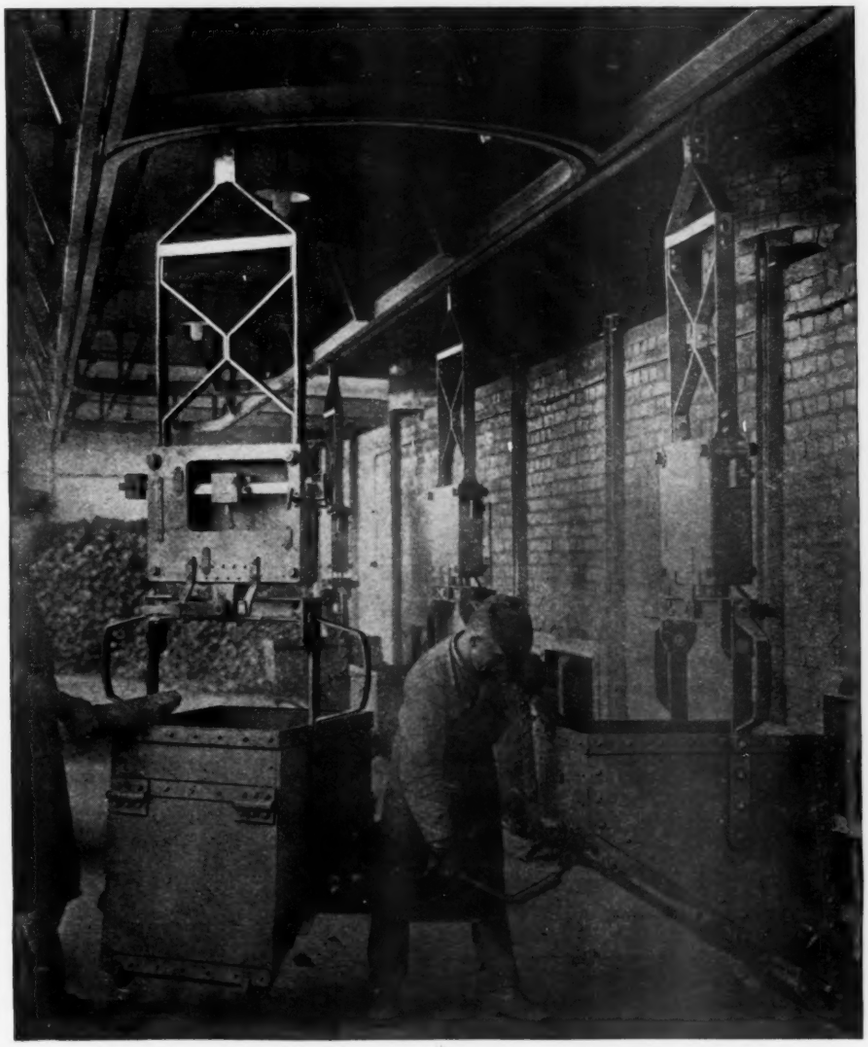


FIG. 7—TROLLEY SYSTEM WITH SPECIALLY DESIGNED, SELF-WEIGHING CHARGING BUCKETS INSTALLED IN AN OPEN-HEARTH STEEL FOUNDRY

the industrial tracks shown on Fig. 3 are utilized for distributing the prepared sand. A simplified plant of similar general design is shown in Fig. 1. In this case the prepared sand is dumped from the bins shown at the right, buckets running on an overhead track by which it is distributed to the molding floors.

German foundrymen have always paid considerable attention to cupola charging apparatus and during the war improvements were introduced in this field. In the last five years there has been a great increase in the use of inclined elevators in place of the ordinary vertically arranged elevators usually employed for hoisting the pig iron, scrap, coke, etc., up to the charging floor. These inclined elevators are peculiar to German foundries. They operate on the blast-furnace skip-hoist principle except that removable buckets are used to carry the charges. A system of narrow-gage tracks is utilized to handle the buckets from the places where they are filled, in the stockyard, to the foot of the elevator. The elevator carriage in which the bucket rests while being hoisted runs between guide rails. The upper ends of these rails are bent toward the cupola, thus forcing the bucket to assume an inclined position and to empty its contents into the chute connected with the charging door. The hoist mechanism consists of a motor mounted on a platform at the upper end of the elevator. This motor drives two symmetrically arranged rope drums through a spur wheel and worm gear. The weight of the bucket and charge is equalized by a counterweight. The general arrangement of an inclined hoist of this character, which has a capacity of 2350 pounds, is shown in Fig. 4. It is controlled from the ground by ropes. It is also possible in case of emergency to move the carriage by hand cranks operating through spur gears. In many cases electrically-driven elevators operated in combination with telphers or trolley systems have been adopted. In plants of this description the telpher cars are loaded either directly from the railway cars or from storage piles or bins. Then the telpher trolleys, which are automatically driven by small individual motors, proceed with their loaded buckets to the elevator by which they are hauled up to the charging floor and then shifted to another trolley system provided at this level. The telpher cars, from which the buckets containing the charges are suspended, move automatically to the furnaces where their contents are dumped without manual labor. A typical layout is illustrated in Fig. 5. In this case the overhead trolley tracks cover the whole stockyard, but the installation of switches at suitable points makes it unnecessary for the telphers to travel the entire distance. The cars are weighed automatically with their loads. After leaving the scales they proceed to the elevator, which is a double one in this instance. This elevator operates at a speed of 3¼ feet per second.

In modern practice in Germany, as in other countries, the molten iron usually is transferred from the cupolas to the molding floors by traveling cranes, overhead trolleys, or small trucks. Cranes usually are used in the large establishments, and the trolleys and trucks in smaller foundries. Hand-operated overhead trolleys are extensively employed in German foundries producing large quantities of small castings. The general arrangement of a plant of this character is shown in Fig. 6. In this case, of course, the overhead system is used for handling liquid iron, castings, sand and other materials. The sand-storage bins are located across the road from the plant proper. This has necessitated arranging a section of the trolley track over the road so that it can be lifted up when the system is not in use, in order to avoid impeding the traffic on the highway.

The automatic telpher system found in so many German plants, it should perhaps be explained, is somewhat different than the usual overhead trolley apparatus employed in American and British shops. The feature of the German overhead system is that the trolleys operate automatically. Each trolley is fitted with a small electric motor, and once it is set in motion it proceeds along the overhead track with its load at a predetermined uniform speed at about 3 feet per second and it may be stopped or started without human attention at any predetermined points by automatic contact switches. This method of handling materials is quite extensively used throughout the German iron and steel industry, and in some cases automatic telpher lines 2 or 3 miles in length are in use.

Fig. 7 shows how the open-hearth furnaces in a German steel foundry are charged by a recently constructed hand-operated trolley system. The buckets have inclined bottoms which permit the charge to drop out readily.

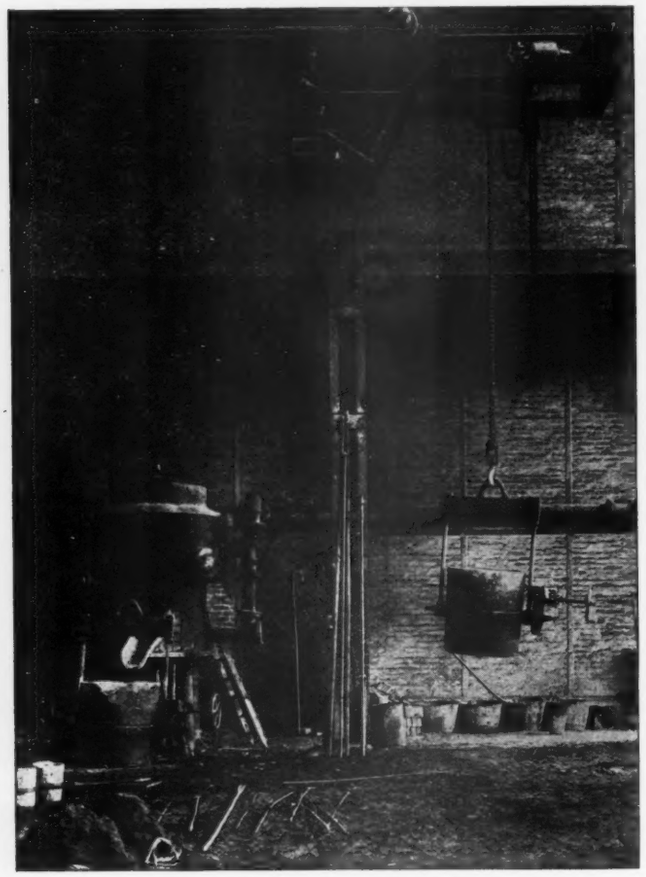


FIG. 9—A MAN-OPERATED OVERHEAD TROLLEY INSTALLED IN A LARGE GERMAN FOUNDRY

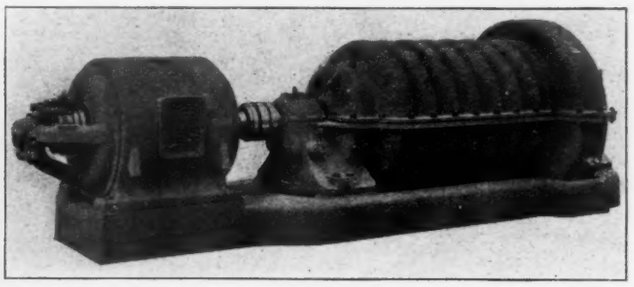


FIG. 10—ELECTRICALLY DRIVEN MULTI-STAGE BLOWER

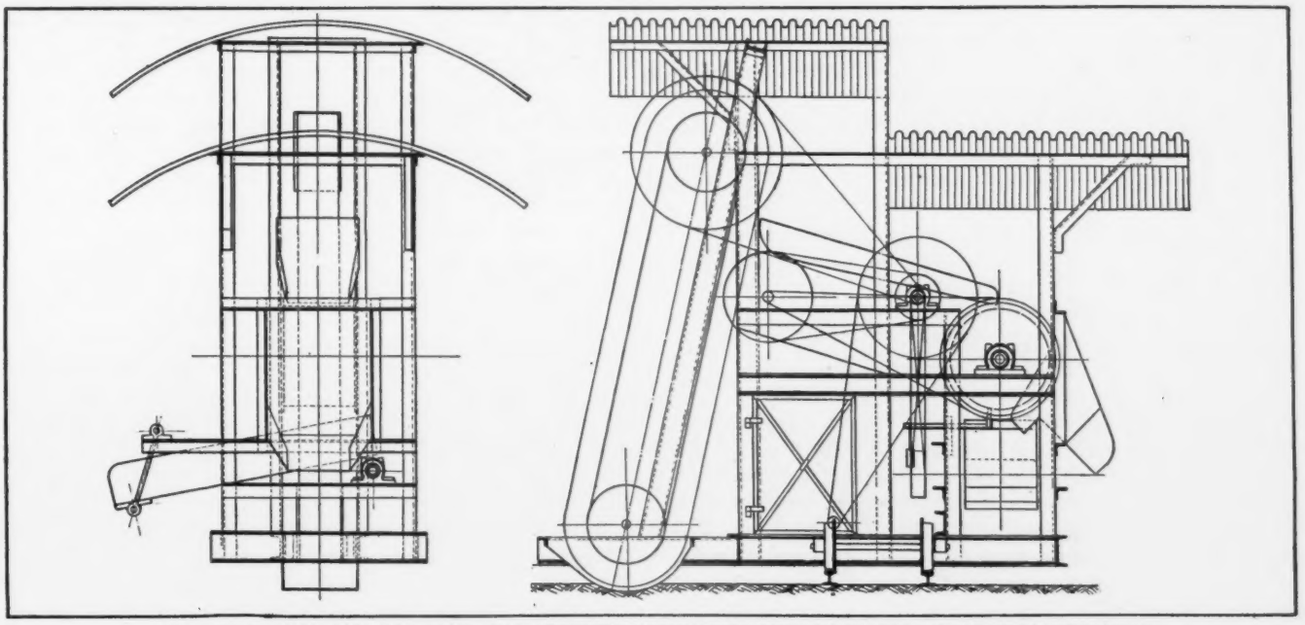


FIG. 11—A SMALL PORTABLE PLANT FOR RECOVERING IRON FROM FOUNDRY WASTES BY MAGNETIC SEPARATION

Each bucket carrier, it also will be noted, is provided with its own scale and weighing mechanism. Another recently constructed German overhead trolley system is shown in Fig. 8. In this case a distributing ladle of the familiar European cylindrical type is illustrated. Some characteristic German molding machines are also shown in the background. The overhead system shown in Fig. 8 may be constructed cheaply. A large number of installations of this character were made during the war. A self-contained trolley provided with an operator is shown in Fig. 9. Installations of this character have been introduced within the past few years for handling molten iron and other materials only in foundries of the largest size. Fig. 9 also shows a typical modern German cupola. It will be noted that the wind box is at a considerable height above the hearth and that an auxiliary tuyere is provided at the hearth level, together with a double row of tuyeres opening out of the wind box.

Waste Products Must Be Utilized

The scarcity of raw materials has resulted in the extensive development of apparatus for the reclamation of foundry wastes. The principal waste products to be dealt with include slag and rubbish. Before the war it was not customary in Germany to work over the slag obtained from the cupola furnaces but a majority of the plants have now been equipped with apparatus for recovering the iron which is lost in this way. It has been found that cupola slag contains frequently from 10 to 12 per cent iron. A cross section of a foundry-slag reclamation plant is shown in Fig. 12. This is a typical German plant operating on the mechanical principle.

When this plant is in use, the slag from the cupola is shoveled onto a floor grid through which the smaller pieces fall at once to a belt conveyor. The large lumps are crushed on the grid by hand until they fall through.

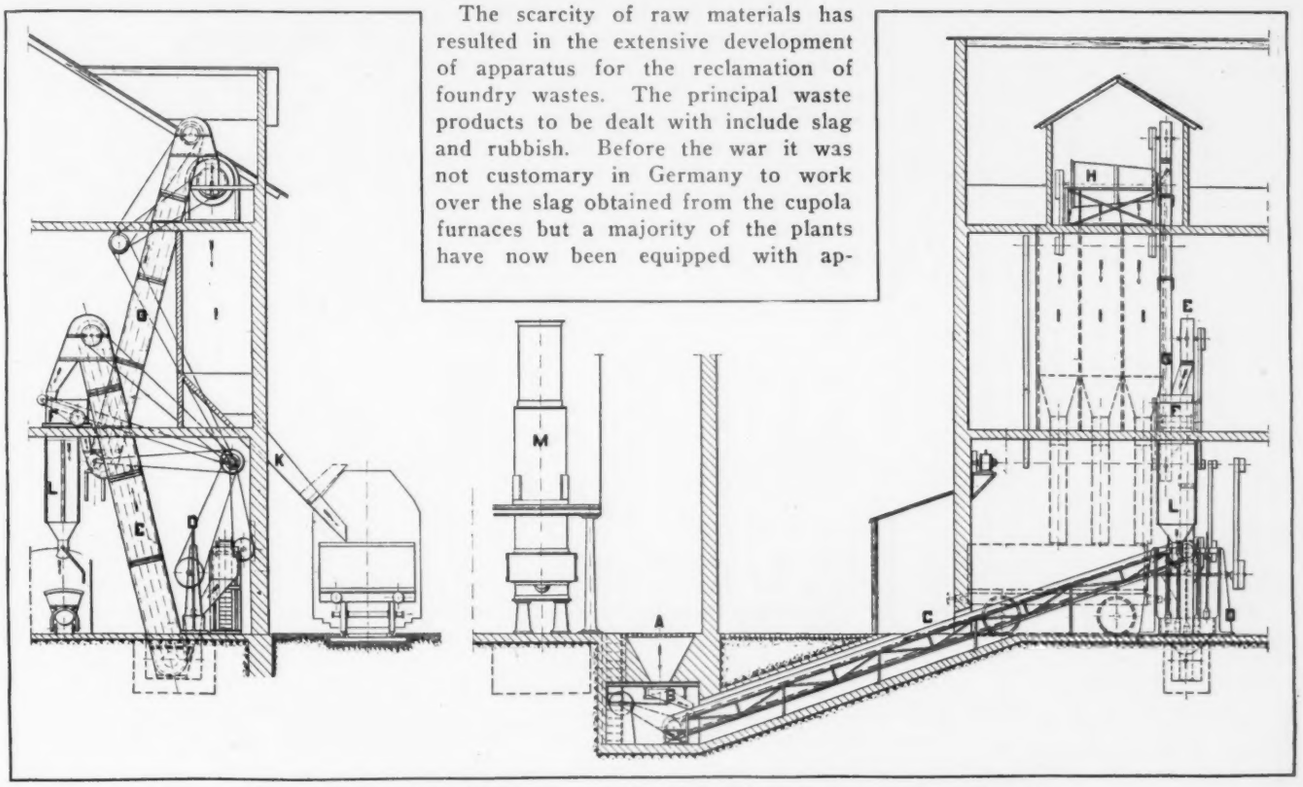


FIG. 12—GENERAL ARRANGEMENT OF A PLANT FOR RECOVERING IRON FROM CUPOLA SLAG

The belt conveyor delivers the slag to an ordinary stamp mill of the type used in western American mining camps. After it is crushed by the stamps, a bucket elevator conveys the slag to a magnetic separator. The iron is removed at this point and deposited in a bin. The iron-free slag is then elevated to a cylindrical screen by which it is sorted out into three different sizes.

The plant shown in Fig. 12 is designed exclusively for the recovery of iron from the slag, but many German foundries are now working over all of their waste products. It has been found that the waste gangway sand, etc., which is usually thrown on the dump contains appreciable quantities of iron, amounting usually to about 2 per cent, and in some cases as much as 3 per cent of the total quantity of castings made. The cost of working over these waste products is small in comparison with the extremely high prices which have to be paid for pig iron and scrap at the present time. Magnetic separation is employed almost exclusively. The costs are confined to the wages of one or two men, the cost of power and the capital charges. Experience shows that under present German conditions even the smallest foundries are able to effect considerable savings by recovering the iron from their slag, gangway sweepings, cupola drop, etc.

A portable apparatus for recovering iron from foundry wastes is shown in Fig. 11. It consists of a carriage, an elevator and a magnetic separator. The material is deposited on the magnetic drum by a shaker which insures an even distribution of material. The drum itself and the driving motor are enclosed in a sheet-metal box for protection against dust. The motor drives all of the movable parts of the apparatus through belts. Before the reclaimed iron is passed to the delivery chute it is conveyed over a shaking sieve which frees it from dust and dirt. This plant is capable of handling 140 cubic feet of waste per hour. When operating at capacity it requires the services of two men to handle it satisfactorily.

Many of the large German foundries now are engaged not only in working over their own waste products but in reclaiming the iron from old dumps as well. There are some plants in operation at present in which waste iron is being recovered at the rate of 10,000 tons per year. In these large plants, the material is delivered in railway cars, after which it is handled in the usual way by elevators, magnetic separators, screens, etc. The iron usually is sorted into different sizes by screens, in order that the higher prices ruling for larger sized scrap may be obtained. This reclaimed iron, which is called *Abfalleisen*, was selling recently for 1500 marks per metric ton.

Specifying Malleable Iron for Castings

BY ENRIQUE TOUCEDA

IN GENERAL, the selection of the proper ferrous casting for use in a given piece of construction is dependent upon: Ability to successfully withstand the abuse to which it will be subjected in service; high rate and dynamic strength, which implies minimum sections for the strains involved, this in turn implying low cost for raw castings, as such are not only less costly in direct proportion to their strength, but their appearance is enhanced thereby; ease of machining, accompanied by a good surface on faced and turned parts, and freedom from unsoundness; which implies beauty of finished castings and low cost due to less loss from defective castings, and smoothness of surface, and trueness to pattern.

In discussing the foregoing a fact should be remembered that is frequently overlooked, namely, that the gray iron, the malleable iron and the steel casting have each a legitimate field of their own quite sharply defined by virtue of certain peculiarities possessed by each particular product. If a bedplate is desired for a certain large and ponderous machine, so dimensioned as to possess sufficient mass to enable it to absorb vibration, it would be unwise to specify that it be made of malleable cast iron. The malleable-iron founders are not at the present time equipped to cast and anneal castings of such size, and as cheapness and weight—obviously not high strength per square inch—are the dominant requirements in this case, the malleable iron casting should not be specified.

In commercial practice the engineer who has placed his contract with a reliable foundry can depend upon a uniformity of product that will rarely have a yield point lower than 31,000 pounds per square inch and frequently as high as 33,000, an ultimate strength less than 50,000 pounds, or an elongation less than 10 per cent. He can quite safely depend upon the integrity of the casting, for the reason that the founder has finally learned through costly experience that freedom from shrinkage depends not only upon correct gate emplacement, but more particularly upon the use of large shrink heads, so located as to eliminate such defects. Castings have been produced commercially as long as 5 feet, with sections at some parts as thick as 3 inches. In regular practice castings varying in weight from 300 to 500 pounds are made daily.

Generally, gray iron castings run heavier than do those made of malleable iron. Consequently there is less sprue and therefore less remelt. Also there is less variation between the composition of the sprue and that of the charge and as a consequence a much larger percentage of scrap can be used in the mixture when making gray iron than is possible in the case of the malleable castings. Assuming the highest fuel ratio in each case, 10 of iron to 1 of coke for the cupola, and 3 of iron to 1 of soft coal in the air furnace, it will be seen that the cost for fuel is less in the former than in the latter case. The same holds true in connection with furnace maintenance. Aside from cleaning and chipping, the gray iron casting is finished when the metal fills the mold, while the white iron castings must be cleaned, taken to the annealing room, packed in saggars, and then charged into the annealing oven and heat treated for a period in most instances of seven days. The saggars must then be removed from the annealing oven, the castings again cleaned and sorted, to the cost of which must be added that of the fuel used for heat treatment, oven maintenance, supervision, and overhead. It can therefore be very easily seen that there must be considerable difference btween the cost of production of these two products. The writer believes that on an average it will easily cost 1 cent a pound more to produce malleable iron than it will the gray iron castings, and at least 30 per cent more to produce steel castings than malleable.

The malleable iron casting is regularly used and can be recommended in the fabrication of railway cars, agricultural implements, motor vehicles, tractors, link belts, chain, fittings, stoves, etc., and is adapted for use for any part of such size as can be successfully made where strength combined with ductility is a necessity and low cost per pound an essential qualification of the product.

From a paper presented at a recent meeting of the American Society of Mechanical Engineers. The author, Enrique Touceda, is a consulting engineer, Albany, N. Y.

A. S. T. M. Changes Specifications

System of Nomenclature for Nonferrous Alloys Is Advanced — Allowable Sulphur and Phosphorus Limits, Increased for Steel Castings in 1918, Will Be Retained Another Year

PROPERTIES of and specifications for cast metals received attention at the twenty-third annual meeting of the American Society for Testing Materials held at Asbury Park, N. J., June 22 to 25. Malleable iron was discussed in a paper on the effect of machining and cross-section on the tensile properties of malleable cast iron, by H. A. Schwartz, National Malleable Castings Co., Indianapolis. This paper which gives a large number of results of tests was presented in the July 1 issue of THE FOUNDRY. There was no report to the general meeting by the committees on gray iron and on malleable iron, but both of these committees held meetings during the convention. The committee on gray iron, Richard Moldenke, Watchung, N. J., chairman, discussed the advisability of formulating a specification for high-test gray iron. This duty will be referred to the subcommittee on general castings, which will outline a specification to be considered by the whole committee. The malleable committee, H. E. Diller, chairman, THE FOUNDRY, Cleveland, last year brought to the society for adoption a specification for general malleable iron castings where high strength is required. Having had this specification adopted as standard the committee did not propose changes at this time.

The committee on methods of sampling and analysis of coal, S. W. Parr, chairman, University of Illinois, Urbana, Ill., and the committee on coke, Richard Moldenke, chairman, submitted brief reports. Both of these committees recommended the standard sieves recently promulgated by the bureau of standards be substituted in their specifications for sieves previously specified.

The formation of a joint committee on steel castings for railroads was announced by committee A-1 on steel. This joint committee consists of representatives of the American Society for Testing Materials, the mechanical section of the American Railroad association, and the United States railroad administration. F. M. Waring, Pennsylvania railroad, Altoona, Pa., is chairman of the joint committee and J. C. Davis, the American Steel Foundries, Chicago, has been elected chairman of the American Society for Testing Materials representatives. It is hoped that this committee will make it possible to submit specifications in 1921.

The rejection limits for sulphur in both basic and acid cast steel and for phosphorus in acid steels had been increased 0.01 per cent above the values given in the specifications, by the society in 1918 and it was thought that this allowance would be removed this year. However, the committee on steel decided that the conditions which caused the adoption of this increased allowance have not yet returned to normal and it was decided to allow the increased limits for another year. The committee proposed a number of changes in the tentative specification for cast steel chain. All of these changes were adopted and the specification will remain as tentative for another year.

PRACTICALLY every industry in the country using or supplying materials is vitally interested in the proceedings of the American Society for Testing Materials. The specifications of this society are being used throughout America and even abroad as exporters recently have found. This society has adopted specifications for many kinds of castings including those made from all varieties of metals. The proceedings of the recent meeting here are given in full as they relate to the foundry industry, and they show the broad scope of the activities of the society in this field.

A paper on molybdenum as an alloying element in structural steels, by G. W. Sargent, Crucible Steel Co. of America, Pittsburgh, showed possible advantages of this element for additions in casting metals. Discussing the paper the author said that molybdenum in gray iron tended to change the structure of the free graphite and to increase the strength of the iron.

A start was made in formulating standard nomenclature for the more than 500 different nonferous alloys in industrial use, in the report of committee *B-2* on nonferrous metals and alloys. The terms are put forth for criticism by societies and individuals and the executive committee of the society has been asked to transmit the report to the British Institute of Metals for its comment. The system of nomenclature is based partly on color classification as may be noted in the following list, which includes all the terms so far proposed:

BRASS

The term *yellow brass* shall be used for zinc-copper alloys only, containing from 63 to 80 per cent copper and having a yellow or brass color.

Example: Composition of alloy: Zinc, 30 per cent; copper, 70 per cent.
Systematic name: Zinc-copper.

The term *red brass* shall be used for zinc-copper alloys only, containing more than 80 per cent copper, in which the color varies from a golden to a copper red.

Example: Composition of alloy: Zinc, 15 per cent; copper, 85 per cent.
Systematic name: Zinc-copper.

The term *yellow-red brass* shall be used for zinc-copper alloys only, containing from 55 to 63 per cent copper, in which range the brass has a yellowish red color.

Example: Composition of alloy: Zinc, 40 per cent; copper, 60 per cent.
Systematic name: Zinc-copper.

Lead brass.—Brass containing more than 0.50 per cent of lead shall be known as *lead yellow, red,* or *yellow-red brass,* according to the percentage of copper it contains.

Example: Lead-yellow brass.
Composition of alloy: Lead, 1 per cent; zinc, 33 per cent; copper, 66 per cent.
Systematic name: Lead-zinc-copper

Tin brass.—Brass containing more than 0.25 per cent tin shall be known as *tin yellow, red* or *tin yellow-red brass,* according to the percentage of copper it contains.

Example: Tin-yellow brass.
Composition of alloy: Tin 0.50 per cent; zinc, 39.50 per cent; copper, 60 per cent.
Systematic name: Tin-zinc-copper.

In cases where other metals are added, these shall be designated by the use of the proper prefix or prefixes:

Example: Manganese-tin-brass.
Composition of alloy: Manganese, 0.50 per cent; tin, 1 per cent; zinc, 38.50 per cent; copper, 60 per cent.
Systematic name: Manganese-tin-zinc-copper.

BRONZE

The term *bronze* shall be used for tin-copper alloys only, containing over 50 per cent copper. In cases where other metals are added these shall be designated by the proper prefix or prefixes:

Example: Aluminum-bronze.
Composition of alloy: Aluminum, 3 per cent; tin, 5 per cent; copper, 92 per cent.
Systematic name: Aluminum-tin-copper.

CUPRO-NICKEL

The term *cupro-nickel* shall be used

for nickel-copper alloys in which copper predominates. In cases where other metals are added these shall be designated by the proper prefix or prefixes:

Example: Iron-manganese-cupro-nickel.
Composition of alloy: Iron, 1.5 per cent; manganese, 2 per cent; copper, 67 per cent; nickel, 29.5 per cent.
Systematic name: Iron-manganese-nickel-copper.

NICKELENE

The term *nickelene* shall be used for nickel-zinc-copper alloys only. In cases where other metals are added these shall be designated by the proper prefix or prefixes:

Example: Lead-nickelene.
Composition of alloy: Lead, 1 per cent; nickel, 5 per cent; zinc, 31.50 per cent; copper, 62.50 per cent.
Systematic name: Lead-nickel-zinc-copper.

F. L. Lasier, connected with the bureau of construction and repair of the navy department, Washington, disapproved of the color classification. This bureau has suggested to the committee, the classification of the alloys alphabetically, such as brass *A*, brass *B*, etc., but the committee had not favored this proposal.

The committee proposed revisions in tentative standards for lead, for aluminum ingots for remelting and for rolling; and for methods of chemical analysis of alloys of lead, tin, antimony and copper. The committee also proposed tentative specifications for sheet high brass; and for aluminum for use in manufacture of iron and steel. Tentative standards; methods for battery assay of copper; and methods for chemical analysis of pig lead, were recommended to the society for adoption as standard specifications. All of these recommendations of the committee were adopted at the meeting.

A highly technical paper involving a great amount of microscopic research was presented by William Campbell, Columbia university, New York. This paper dealt with the constituents of certain brasses and bronzes as influenced by the composition of the alloys. The importance of the paper was emphasized by G. H. Clamer, Ajax Metal Co., Philadelphia, who said that it explained why bronzes with high tin content become hard and brittle when a large amount of zinc is present, and showed the necessity for increasing the copper when an increased amount of tin is present.

Results of fatigue and impact tests of aluminum alloys are shown in a paper by W. A. Gibson, Aluminum Castings Co., Cleveland, and comparisons are made with various grades of steel.

A new method of testing galvanized coating, by which the sample is not destroyed, was described by Allerton S. Cushman, Institute of Industrial Research, Washington. This method is based upon the measurement of the amount of hydrogen generated when a sample of a definite area is subjected to the action of concentrated hydrochloric acid to which a small amount of antimony chloride has been added. Apparatus has been devised for covering a portion of the sample with a tinned iron ring. This ring is closed at the one end by a soft rubber stopper, thereby making a cell into which the acid solution can be run. The evolved hydrogen is carried to a measuring burette by a tube, controlled by a 3-way stop cock. A tight contact is preserved between the bottom of the metallic ring and the galvanized surface by a plastic molding clay placed around the joint. The chief advantage of the method is that galvanized culverts or other objects may be tested without destroying the sample. They may be tested at different spots and the test can be carried on after the culvert is installed if desired. Spots made by the acid may be regalvanized or painted to preserve the steel. The results of Mr. Cushman's investigations show the method to be accurate and to give concordant results. Small samples may be tested by placing them in a cell formed by the apparatus against a material which is not attacked by the acid. In this method the results can not be reported as zinc per square foot but the total amount of zinc on the samples can be ascertained.

Columbus Convention Will Be Largest Ever

It is evident that the annual convention and exhibition to be held under the auspices of the American Foundrymen's association at Columbus the week of Oct. 4 to 8 inclusive will be the largest and most comprehensive affair of that character ever attempted in this country. The Philadelphia meeting of last year created a record both for the number of foundrymen in attendance and the number of exhibitors. Already, three months before the date set for the Columbus convention the total amount of exhibition space reserved and contracted for is over 51,000 square feet or within less than 9000 square feet of the total area in use at the Philadelphia exhibition.

Last year's exhibitors to the number of 141 already have made their space reservations. These, with 85 additional who make up last year's total and who have merely deferred making application and the number of new manufacturers who undoubtedly will take advantage of this occasion lends evidence to the belief that the Columbus convention and exhibition will be the banner event in the history of the association.

So far as possible exhibitors are given the locations they prefer; but this is sometimes physically impossible. The different power driven units must be grouped together where power is available. A floor plan of the buildings and also a plan showing the location and character of the different available power units has been sent to all prospective exhibitors. Copies of the plans and any other information may be secured from C. E. Hoyt, Marquette building, 140 South Dearborn street, Chicago.

Will Make Abrasives

The M. T. K. Sales Corp. has been organized at Rochester, N. Y., and incorporated under the laws of New York state to distribute a new bearing abrasive which is intended to eliminate the necessity of scraping bearings. The product is manufactured by the M. T. K. Products Co., Seattle, which, it is understood, contemplates moving its plant to the east in the near future. It is said that the abrasive will not cut iron or steel and hence will not injure shafts or other working parts, and after a few minutes of cutting, it breaks down and becomes a harmless residue incapable of further cutting. The officers of the M. T. K. Sales Corp. are: President, Benjamin C. Mathes, Mathes Sales & Mfg. Co., Rochester; vice president and consulting engineer, William D. Jones, formerly of the Symington-Anderson Co.; secretary, Willis P. Anderson; treasurer, Averill B. Pfeifer.

Study Microstructure

The results of a study of the microstructure of iron and mild steel at high temperatures are published in scientific paper No. 356 of the bureau of standards. It was found that when polished metal specimens are heated in vacuo. a record of structure which exists at the particular temperature used is inscribed on the polished surface of the specimen.

Charles H. Small recently has withdrawn from the firm of Small, Shade & Co., San Francisco, to establish a business of his own for the sale of railway industrial mining and marine equipment. Mr. Small previous to the war was connected with the American Brake Shoe & Foundry Co., at the Mawah, N. J., plant, and was representative for that company at the Panama-Pacific exposition in 1915.

Attaining Steel Casting Quality

British Practice Recognizes Need for Co-operation Between Foundrymen and Engineers—Changes in Design Recommended to Meet Shrinkage Troubles Encountered in Cooling

BY GEORGE F. PRESTON

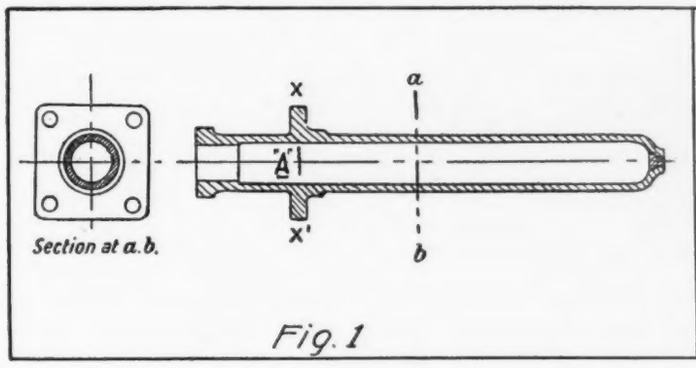
STEEL castings are used exclusively for diverse purposes. Some difficulties which have arisen in the foundry have been due to the nonappreciation of the fact that, at the recalescence point Ar_3 in the cooling curve of steel, contraction is arrested and an actual expansion takes place. In an ordinary 0.3 per cent carbon steel the expansion between 690 degrees and 650 degrees Cent. is approximately equal to the amount of contraction between 790 degrees and 710 degrees Cent.; therefore in some castings of intricate design reversals of stress do not occur simultaneously in all parts. If such castings are left in the sand or on the floor, cooling at unequal rates in various parts, contraction will be taking place in some portions while in others expansion will occur, when adjacent members are in a plastic, or weak condition, resulting in cracks. When such difficulties due to reversals of stress occur, modification in design by the engineer, so as more nearly to equalize the thickness in critical parts, affords one means of remedy. Another is by *chilling* or using one of the various methods, not altogether favored.

Most steel-founders probably have experienced cases where the use of chills has been followed by cracks in the casting, through the effect of not having been fully considered. An alternative method which might be adopted for some castings is to arrange for the cooling from a temperature above 770 degrees Cent. to take place in a preheated furnce, care being taken to shake out the casting at a temperature sufficiently above this to enable it to be sealed up in the furnace before the temperature has fallen to the danger point. This method was adopted with success in a casting for a ship of world-wide repute, having a heavy flange, or seating, about the middle of its length.

Cases occur where the engineer would be put to increased cost, or experience a difficulty, by omitting some portion objected to from the founder's standpoint, as, for example, in a cylinder or tube such as that shown in Fig. 1. This casting has a heavy flange, XX′, 2 to 4 feet from the mouth, and used only for bolting the cylinder onto its base. The flange produces two difficulties to the makers. One is to feed the square flange to ensure soundness; the other, which is possibly of more consequence, is to prevent pulling in the bore of the cylinder about the center of the width of the flange at *A*. In such cases probably no objection could be raised to introducing in this heavy flange a frame Fig. 2, previously cast in steel, to act as a *chill*, thus equalizing the rate of cooling and also insuring an absence of cavities in the surrounding metal. There would be little theoretical and probably no practical loss of strength, for unless the chill was of excessive thickness it would to a large degree be fused by the fluid-steel.

In important castings subjected to severe stresses, such as large gun mountings, the fullest and most careful consideration should be given by the designer to placing heavy masses or sections of metal where adequate arrangements can be made for feeding. In the absence of feeding heads, the thinner surrounding sections will *draw* on such reservoirs of molten steel and result in unsoundness or *piping* in parts where it is of the utmost importance that a large factor of safety should be provided.

A ship's stem might be instanced as an illustration of this important point. The position and size of necessary feeding heads to secure soundness, or, on the other hand, of alteration in design to obviate them is relatively more difficult of general solution than the question of producing sound steel ingots. Such a ship casting usually has heavy brackets cast between the webs at the deck positions, thus further increasing the relative mass at these places. There is little doubt that a more satisfactory casting would result by breaking the continuity at the junction of the bracket with the section of the webs, particularly at the extreme forward point, as such recesses in the deck brackets can safely be filled in later by electric welding and caulked to make them watertight. If feeding heads are placed over these brackets, the steel will remain fluid at these places after the general contour of the stem casting has solidified, thus tending to unsoundness, distortion, and troubles through contraction. Another point which should be borne in mind in connection with castings of this type is that during the period of cooling the curved contour will tend to approximate a straight line. Allowance therefore should be



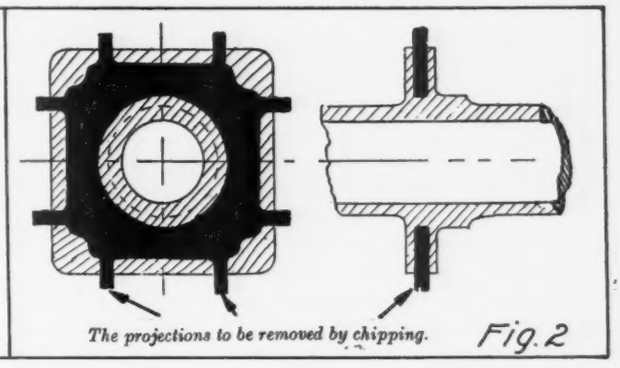


FIG. 1—CYLINDER CASTING WHICH DEVELOPS PLANE OF WEAKNESS DUE TO COOLING STRAINS FIG. 2—SUGGESTED USE OF STEEL CHILLS TO ELIMINATE DIFFICULTY SHOWN IN FIG. 1

Abstracted from a paper presented at a recent meeting of the British Iron and Steel Institute.

made by the patternmaker for this tendency, particularly toward the ends.

Modifications in design would be more satisfactory in some of the cases, parts being made separately where possible. This has sometimes the objection of increase in cost of machining and handling, but cheapness should not be the sole consideration in making such castings.

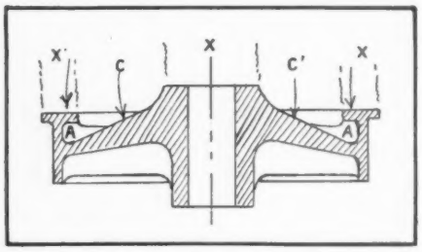


FIG. 3—CASTING WHICH HAS LIGHT RIBS TIED INTO INTERNAL FLANGES, PRODUCING SECTIONS WITH UNEQUAL COOLING RATES

Castings of the type shown in Fig. 3 sometimes are sought with light ribs, *AA*, tied under internal flanges and also to a heavy plate or cone center, *CC'*. Such ribs naturally cool at a much quicker rate than the heavy disk portion and feeding heads, *XX'*, and are therefore in considerable tension, where the members join the periphery, when the plate portion and the center boss have reached their maximum contraction.

It likewise is difficult to insure satisfactory castings of the design shown in Fig. 4. This shows a disk, or wheel, having spokes of heavy rectangular section on which are superimposed a plate of lighter section. Drawing, or other defects, probably will appear in the plate over the center of the spoke or rib, see *X* on section *ab*.

It must be admitted that a careful consideration by the management and a joint discussion with all foremen responsible for seeing work through the different shops would lead to the production of better castings; as it sometimes is seen, after a pattern is completed, that, if it had been made differently in some respect, to allow a modification in the method of making the mold, provision could have been made for more efficient feeding, and also for guarding against contraction.

Such expedients as inserting tubing of small diameter rammed with sand, in lieu of cores where they are surrounded by large masses of steel probably would then be arranged and much expense saved in cleaning and machining. It is well known that bent or broken cores cause endless trouble when the casting reaches the drilling machine; in fact, in many instances it would be far cheaper to omit small bolt-hole cores altogether.

Steel founders of repute have overcome the trouble of honeycombing and blowholes in castings. These, in earlier days, were considered almost unavoidable, in fact it has been stated in the past that the presence of blowholes might be taken as a "guarantee of quality in other respects!"

Given steel properly melted and with suitable percentages of silicon and manganese, and care in making and drying molds, little trouble is experienced from blowholes.

The elimination of honeycombing has resulted in largely increased productions of cast steel blanks for machine-cut gearing and similar castings, on which a large amount of machining is done. Such a defect is shown in Fig. 5. Arrangements should be made for the fluid steel to enter the mold at the bottom, and whenever possible a centripetal action, commonly termed *spinning*, should be secured. Suitable risers and feeders should be provided where necessary, to bring any dirt up into the heads. It usually is advisable to cast such articles quickly.

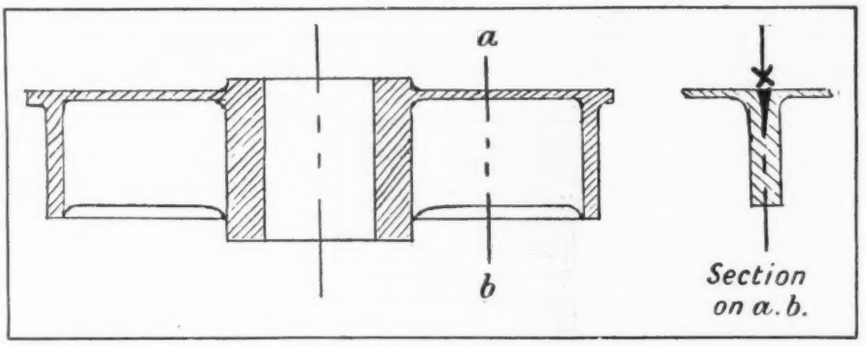


FIG. 4—WHEEL HAVING HEAVY RECTANGULAR SECTION WITH A PLATE OF LIGHTER CONSTRUCTION

Castings of this kind frequently are produced without the slightest defect, provided the design be favorable. One cause of trouble has been the attempt to supply blanks of fairly large diameter with solid disk, or plate, centers, which have a pronounced tendency to show cavities in the rim, practically in the position where the roots of the teeth are when these are milled out. This is due to the rim being heavier in section than the disk and therefore remaining fluid longer, and also, in cases where the change in section is not so great, to difficulty in arranging for adequate feeding at this place.

It is preferable to adopt H-section arms, but it is then found expedient to break the continuity of the metal at the junction with the rim by placing a narrow core through the webs of the arms. If objection be made to such a method resulting in any weakening of the casting, this easily can be obviated by increasing the strength of the faces, or top and bottom flanges, of the arms by having larger radii between them and the rim, as noted in *XX'*, Fig. 6, which is preferable from the founder's standpoint as well.

The same problems are encountered in the production of smaller castings, weighing from a few ounces upward, as supplied to motor and general engineering firms. The difficulties might be overcome in many instances if it were possible to arrange to submit suggested designs to some steel founder of good standing.

To give one example only: Axle-box guides for locomotives, still are made as shown in Fig. 7, *A*, which any user will understand generally results in drawing at *X* and *X'*, in addition to causing extra work in the machine shop owing to the absence of tool clearances, instead of a more gradual change in section and also of radii at the corners, as illustrated by Fig. 7, *B*, the more usual present design.

Innumerable examples might be added affecting practically every type of steel casting made, but the desire at the moment is to persuade the engineer that exchange of views is of importance not only in respect of the production of castings without inherent weaknesses, but also in regard to the use of differing qualities of steel, or of special alloy steels, for various purposes.

Providing suitable test bars, in the case of some forms of castings, is important if sound pieces for tensile and bend tests are to be insured. This should not be left to the discretion of the molder, who usually is governed by considerations of convenience in respect to the flask used for the job. The question is well worth considera-

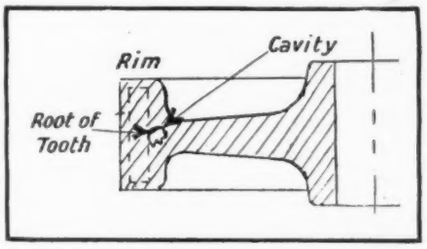


FIG. 5—DEFECT DEVELOPED IN A CAST GEAR BLANK—MACHINING ALONE WILL DISCLOSE THIS DESTRUCTIVE CAVITY

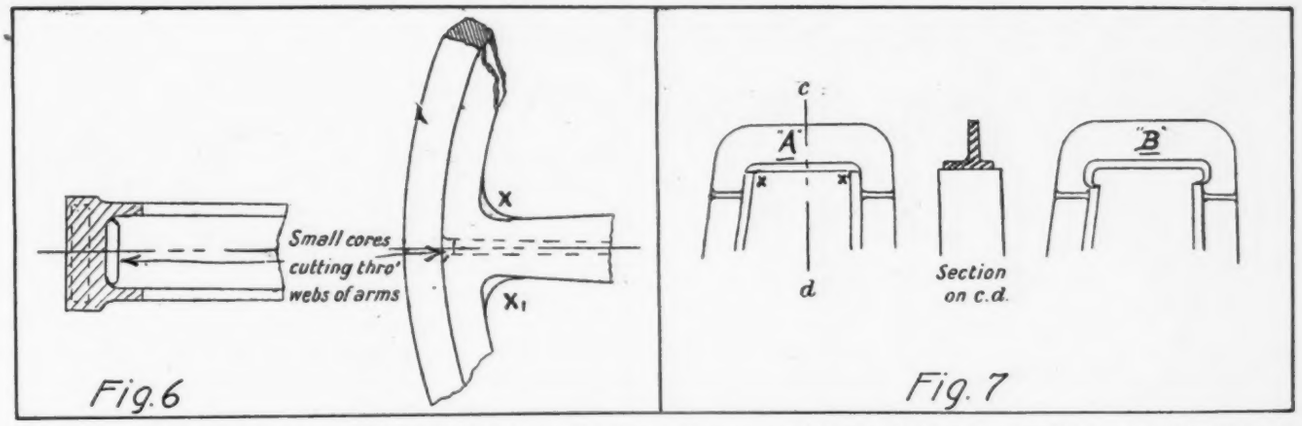


FIG. 6—SUGGESTED METHODS FOR OVERCOMING BREAKAGE BETWEEN WHEEL AND SPOKES, THROUGH USE OF SMALL CUTTING CORES OR LARGER FILLETS FIG. 7—REDESIGN OF LOCOMOTIVE AXLE-BOX GUIDES

tion by the management, owing to the loss incurred if a satisfactory casting be rejected solely through inability to obtain test pieces free from defects. In some cases, on cutting up a casting for test to represent others produced from the same cast of steel, or in breaking it under the drop hammer for remelting, it has been found that the casting was perfectly sound, defects appearing in the test pieces only.

It also is highly advisable to provide spare test pieces, as cutting pieces from rising heads often results in disappointment from causes such as segregation. Consideration should be given to such points as feeding the test bars, and whether the steel is able to flow freely through the part provided for tests. No dirt carried off the face of the mold, etc., should be trapped, and the test bar should not be sound at the expense of unsoundness in the casting itself, or *vice versa*.

For small castings it is advisable to treat the test bar as a separate casting but connected by a *spray* or runner of sufficiently large sectional area to ensure that the test piece is securely attached to the group of castings, or to the single casting, as the case may be, and also to give an adequate flow of steel into the test bar, on which a separate feeding head should be superimposed. A suitable design of test piece for this purpose is shown in Fig. 8.

When molds are made by machines, it will be found convenient to arrange the patterns on the plate, whenever possible, so that one or more patterns can easily be removed and a test bar included in place in several of the molds which will be put down for each cast. Special attention must necessarily be given to the method of fastening patterns to the plate to prevent any possible chance of displacement through frequent changing.

To ensure satisfactory test results it is necessary that the annealing or heat treatment should be carefully carried out. It is advisable to have some means for recording temperatures, readings being taken in various positions in larger furnaces until it is ascertained that a uniform heat is obtained in the particular type of furnace in use. The furnace attendant, if left to himself, often appears specially interested in recording flame temperature rather than those of the castings under treatment. If personal attention is given to this matter of heat treatment, economies in working, as well as higher quality material, may result, as small modifications in furnace design, for instance slight alterations in the sizes and positions of admission ports, may be found advantageous.

The most satisfactory furnace is one in which the rate of cooling down at the critical temperature can be varied, as then it is possible to obtain small variations in the maximum stress where castings are made to specifications.

Owing to the difficulty sometimes experienced in passing with reannealing

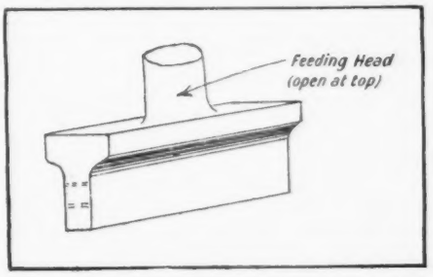


FIG. 8—DESIGN OF TEST PIECE WITH SEPARATE FEEDING HEAD

material, which has given results two to three tons over, or under, the maximum stress specified, it would appear that some engineers have not yet realized that the rate of cooling round the recalescence point of the steel governs the maximum stress. A substantial increase, or decrease, can be made by accelerating or lengthening the period of cooling through this range.

It is found in practice that heating to a temperature of about 950 degrees Cent. is advisable to insure *breaking down* the cast crystalline structure, the final structure being, of course, coarser or finer according as the rate of cooling through the critical range is slow or rapid. This temperature is much higher than is theoretically necessary, but experiments show the necessity for the higher temperature. The original crystallization of a casting will, of course, be governed by the mass of metal and the rate of cooling after casting. The length of time necessary thoroughly to soak castings and complete the *breaking down* throughout is a matter of judgment depending on size, thickness of metal, position the castings are loaded in the furnace, and other considerations.

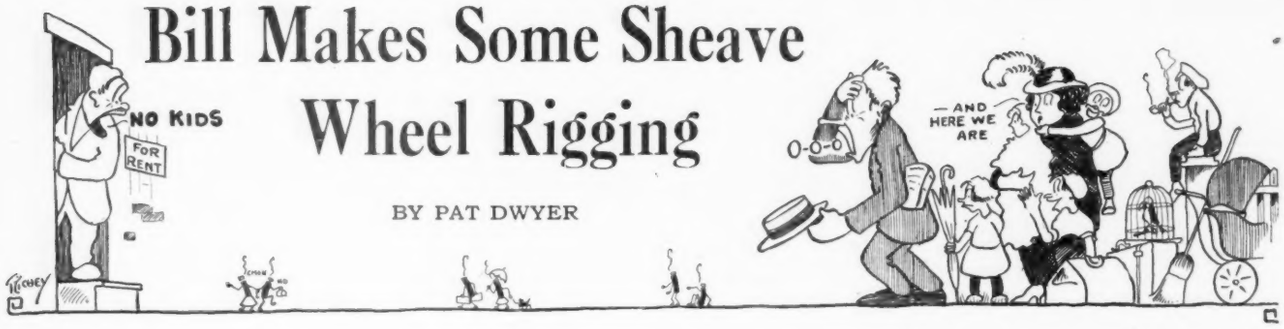
When dealing with large castings of heavy section it is advisable to pack them well up from the floor of the furnace. Pieces having heavy cores should be rough cleaned before being placed in the furnace.

Generally, if arrangements are made which will admit of castings being cooled quickly through the critical range without risk of distortion or setting up of stresses, through currents of cold air impinging on one part of a casting, an increase in the maximum stress without decrease in the elongation can be expected and, owing to the closer structure, better results from bend and shock tests will be obtained. Many cases have been noted where mild qualities of steel, as cast, have given practically the same maximum stress and elongation per cent as after annealing, for instance a breaking strain of about 97,000 pounds per square inch with 28 to 30 per cent elongation in 2 inches. However, untreated samples fail to give anything approaching satisfactory bend tests.

It is possible that manufacturers of high quality castings may soon consider that some form of shock test might not be against their interests if lower grade material, less suitable for the purpose required, and supplied at a cheaper rate, be in this way eliminated from competition.

Bill Makes Some Sheave Wheel Rigging

BY PAT DWYER

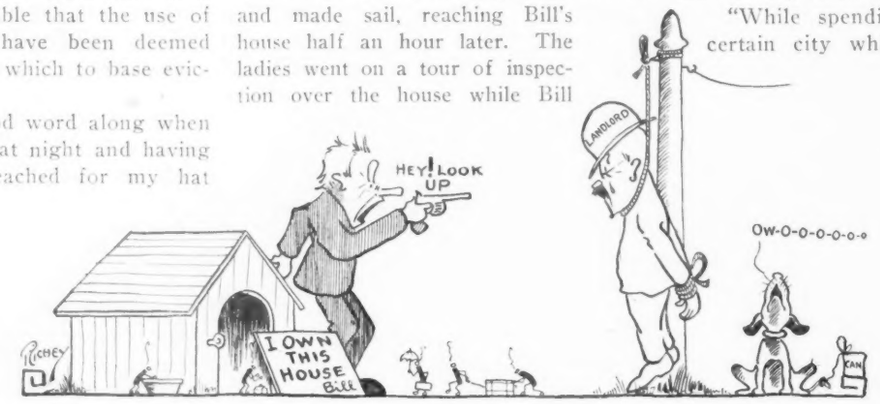


BILL has been so busily engaged in house hunting for the past few weeks that he had no time to spend an occasional hour in our midst. He called us up the other day and extended an invitation for Herself and myself to come over and see the *joint* he had landed. His intentions are of the best and his heart is in the right place but his use of the vernacular is sometimes startling, and in this instance would have given his new landlord heart failure if he had heard him. In fact under present conditions it is not at all improbable that the use of the term would have been deemed sufficient cause on which to base eviction proceedings.

I passed the good word along when I reached home that night and having finished supper reached for my hat and proposed that we start on the pilgrimage. We did eventually get under way, about an hour afterward. The members of the home guard were given such an extended and elaborate set of instructions on what to do and how to do it under any and all conditions, probable and otherwise that I finally was moved to suggest in a friendly way that we were not going on a tour around the world but in all probability would be back in about three hours. This well meant and totally disinterested observation was dismissed frigidly. I was told that it was a mercy and a special dispensation of Providence that I had some one who realized her obligations to look after the house and children. Furthermore, it was intimated that I had no conscience and it would serve me right to come home some night and find the baby hanging on the clothes line, the other children kidnapped and the house burned down.

I pointed to the fact that we had gone out together a million times, more or less, since we were married and none of these heart rending events had come to pass. With the mental dexterity peculiar to her sex, this little piece of logic, which I had confidently advanced with the expectation of justifying my position, was neatly turned to knock the props from under my contention. I was told that I had always found everything in a satisfactory condition on my return solely owing to the moral effect produced by the general orders which she always made it a point to issue before going away from the house for even the shortest time.

We finally heaved up the anchor and made sail, reaching Bill's house half an hour later. The ladies went on a tour of inspection over the house while Bill



WHY PAY RENT—OWN YOUR OWN HOME—PLEASANT OUTLOOK AND AIRY DINING ROOM

and I stayed on the verandah where he unburdened himself of his views on profiteering landlords and other classes of pirates who infest our fair land at the present time. I am willing to admit that I encouraged him shamelessly and shall always feel that I owe him a debt of gratitude for the able, skillful and whole hearted way in which he expressed sentiments which lie close to my heart. I always have felt a fear of employing Bill's flowing style due to an early training which taught me to expect that the direct consequences lay in the hereafter for those who used that kind of language.

"This moving business certainly gets me peeved," said he. "No sooner do I get fairly settled in a place than the bird who owns the house either sells it or jumps the rent to a point where if a man pays it he has to live on air. I am a firm believer in the 'Till death do us part,' form of marriage contract but sometimes I wish I was back again in the old carefree happy days when I skipped blithely from one boarding house to another and had nothing to pack but a trowel, a double ender and a few long lifters. When I moved from place to place on the foundry circuit, I had nothing to trouble me. I had a good time, plenty of money for my immediate needs. I had the opportunity of satisfying my young and ardent curiosity and I picked up some interesting pointers on the foundry business as I went along.

"While spending a season in a certain city which modestly hides its charms under a canopy of smoke, I discovered several new wrinkles in the molding of sheave wheels. 'Tis true I did not work or visit in every shop in the town for when the hot weather arrived I migrated to a more congenial climate. However, I saw enough of them and their practice to convince me that there are almost as many ways of making sheaves in that town as there are varieties of pickles put up in its famous pickle foundry. The name of the city is immaterial, but if I were to hint that it is situated at the junction of two rivers in a great coal producing state you would probably be able to guess the name before exhausting more than two-thirds of the letters in the alphabet."

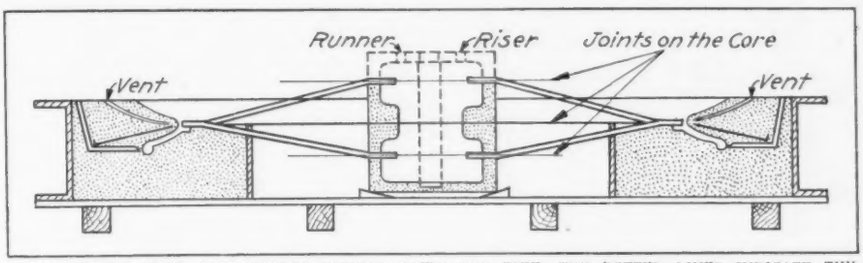
"Oh, cut out the circumlocution," I said. "I know the city you are talking about; it is down in a valley and the people have to climb a hill a mile high when they want to see the sun."

"Have it your own way," said Bill. "Not being either a mountaineer or a billy goat, I never saw the sun while I was there so you probably are right. I have done so much prowling around dark foundries all my life that I never noticed whether the sun was shining

in Pitts—Oh, well! Let it go at that, the question of sunlight has nothing to do with the story anyway.

"I worked in one shop where they made great numbers of sheave wheels of all sizes and some of the rigs in use were certainly time and labor savers. One rig in particular for making 4, 6 and 8-foot wheels appealed to me and I made a similar set of rigging for the same class of castings in a shop I had charge of later.

"The sheaves to which I have reference are those having wrought iron or steel spokes attached to the hub and rim after the manner of bicycle spokes. The hub is long and while the spokes enter the rim on the same horizontal plane as the joint of the pattern, they enter the hub alternately up and down; that is half the total number of spokes enter near the top of the hub and the other half enter near the bottom. Owing to the contraction of cast iron the hub cannot be poured until the rim has cooled and contraction ceased. Therefore, it is customary to pour the rim in one day and the hub on the next.



DRAG OF THE MOLD JUST BEFORE CLOSING DOWN THE COPE—THE DOTTED LINES INDICATE THE APPEARANCE OF THE ASSEMBLED CORE ON THE FOLLOWING DAY—THE LIFTING RING IS PROVIDED WITH THREE V-SHAPED PROJECTIONS EQUALLY SPACED ON THE OUTSIDE FOR GUIDING IT INTO PLACE

"The rim of a 6-foot wheel will contract approximately ¾-inch which means that the inner ends of the spokes will be ⅜-inch nearer the center of the casting than they were when they were placed in the mold. The hub of the same wheel generally is about one foot in diameter having a total shrinkage of ⅛-inch. Therefore, it will be seen that the contraction at any point on the circumference of the hub is only 1/16 of an inch; an amount which serves only to put a slight tension on the spokes.

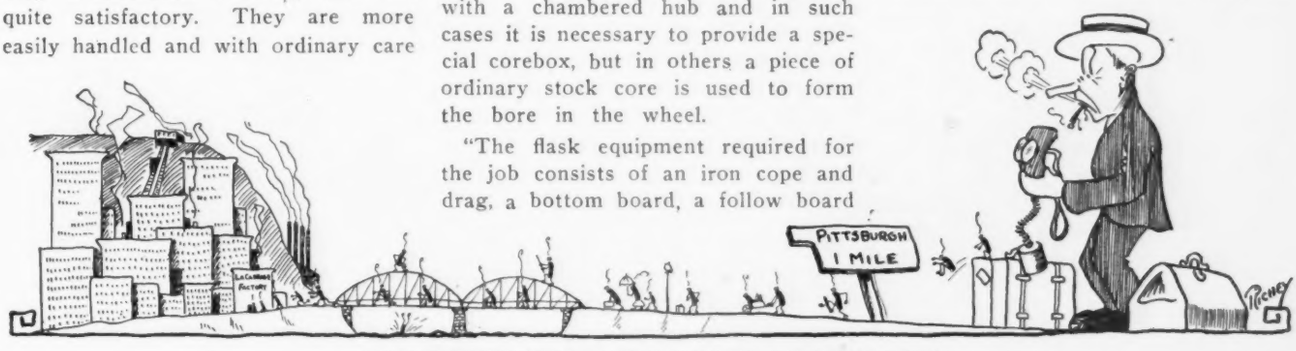
"Where great numbers of these wheels are made, it might be advisable to use iron patterns but under ordinary circumstances wooden patterns are quite satisfactory. They are more easily handled and with ordinary care will last indefinitely. I have a case in mind where the same wooden patterns have been in use for over 10 years. They have not been in constant use all that time but I should say off-hand that 100 wheels have been made off them each year during that time.

"For illustration, take a 6-foot wheel and consider in detail some of the pattern making and molding features. A full sized layout is made on the board and the necessary stock for the rim cut out and built up roughly to conform to the desired shape. The rim is built in two halves, dowel pins inserted in two or three places after which it is placed in the lathe and turned to the finished shape and dimensions. A thin wooden templet accurately made to conform to a sectional view of the casting is used to check the work as it progresses. After the rim has been turned and finished it is removed from the lathe and placed on a suitable bench where the hubs with prints attached for the spokes are fitted on. It is then given a couple of coats of black shellac varnish and is ready to go into the foundry for service.

"The hub of the wheel is made in a dry sand mold composed of four sections of dry sand cores. Since both halves of the hub are symmetrical, only two core boxes are needed. Two cores from each box make a complete hub mold, the top and bottom cores being made from one box and the two center sections made off the other. Some of these wheels are made with a chambered hub and in such cases it is necessary to provide a special corebox, but in others a piece of ordinary stock core is used to form the bore in the wheel.

"The flask equipment required for the job consists of an iron cope and drag, a bottom board, a follow board and an iron lifting ring for carrying the body of green sand which forms the groove in the rim of the wheel. As the rim of the wheel is the only part cast in green sand it is not necessary to ram any sand in the center of the flask. Both cope and drag are barred and consist of the ordinary style of flanged outside ring and a plain ring about 3 feet in diameter on the inside. The bars in the cope follow the parting line closely, but the bars in the drag are shallow and serve principally to support the center ring. The inside ring in both cope and drag is split to allow for contraction. The follow board is made to conform to the shape of the pattern and also provides a depression around the perimeter of the wheel to form a seat for the lifting ring. This part of the drag is rammed hard and there is no need to go over it with a trowel to make a parting after the drag has been rolled over. In making the mold the follow board is placed on the floor in the usual manner; care being observed to see that the battens are bearing. These boards usually are stiff but unless they are evenly supported underneath, the force of the ramming will throw them out of shape and produce a distorted wheel. The pattern for the wheel rim is then set in its place after which the drag is lowered into position.

"Under ideal conditions it might be possible to ram the drag and roll it over without using a bottom board but in actual practice it has been found more convenient to clamp a bottom board on the drag before rolling it over. One reason for this is that the bars in the drag, to facilitate ramming, are spaced further apart than the bars in the cope. In fact some drags are provided with only four bars or just enough to hold the inside ring in posi-



FOND MEMORIES OFT THE WEARY TRAVELER HOMEWARD TURN

tion. After the drag is rolled over and the follow board removed, parting sand is sprinkled over the flat seat for the lifting ring and the latter set in place. Facing sand is riddled on and a number of long spikes, pointing toward the center of the wheel, laid closely together around the rim. The other half of the pattern is then set on and sand shoveled in until the space between the pattern and the lifting ring and also the space between the lifting ring and the wall of the drag are completely filled. The sand in the groove is tucked lightly with a hand rammer and the fingers, but the remainder of the sand is rammed quite firmly.

"A parting is then made flush with the joint of the drag and depressed a little at the edge of the bead which encircles the rim of the pattern. The cope is set on and four gate pins located; two for runners and the other two for risers. Four long wood screws also are inserted in the pattern, their upper extremities protruding above the cope, before any sand is shoveled in. When this precaution is not observed the pattern is soon filled with holes.

"Before lifting the cope a rod is passed through the eye of each of these screws and tightened with a wedge. When the cope is lifted the upper half of the pattern comes with it. The cope is rolled over for finishing and then the lifting ring carrying the groove of the wheel is taken out of the drag. To get an even tension on the ring, turn-buckles are attached to the end of the crane chains. The lower half of the pattern is drawn, the mold finished and the lifting ring lowered back into position.

"The cores for the hub are set by taking the first pair and wedging them up level with the parting line of the mold. Channels are cut with a gate cutter for each alternate spoke from the ends of the prints to the openings in the inside drag ring after which the arms are set in place. The mold then is closed and made ready for pouring. On the following day the cores are reassembled, clamped together and the hub poured. It is customary to run some metal through the riser or flow-off in case the iron should kick or blow off the ends of the arms."

"I should like to hear some further details," I said, "but I hear the sound of fairy footsteps approaching and you know what that means."

"Good bye," said Bill; and then he added reminiscently, "Yes, sir, Pittsburgh was certainly some town in those days."

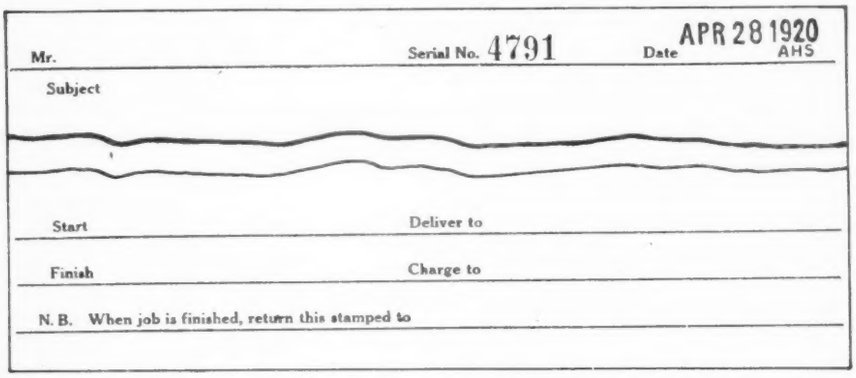
Verbal Orders Tabooed in Small Shop

Large manufacturing companies generally appreciate the advantages of written orders. One establishment is so insistent on this point that it has printed in red ink at the top of all its internal forms *Verbal Orders Don't Go.* While the management in big plants generally insists on the use of written orders about the plant, the man who has a small shop and supervises all the work himself seldom regards this as necessary. He knows all the workmen personally and either speaks to the man whom he wishes to direct, or sends word to him by one of the other workers. This is the easiest way and if results always are satisfactory, there is no need of going to the trouble of writing instructions or directions incident to laying out the work.

However, it sometimes is found that the verbal order does not bring the desired results. Possibly the one directed forgets to do the work or he may misunderstand the order. Occasions like these have caused A. H. Smith, secretary and treasurer of the Hills-McCanna Co., Chicago, to adopt the policy of writing all orders for the shopmen. The company is an average medium sized brass foundry and Mr. Smith is superintendent. He comes into direct contact with all the workmen and easily could give verbal instructions, but he has found it advantageous to write all orders.

A consecutively numbered form such as the one shown in the accompanying illustration is used. The name of the man to whom the order is addressed is placed on the top line with the serial number and the date. The main body of the form is used to detail the work to be done. Below is space for stating the time the work is to be started and when it is to be finished. A space also is reserved so that the workman may be told to whom he should deliver the finished task. The job or department to which the work is to be charged is stated in the order on the line marked *charged to.*

These slips are made out in duplicate so that Mr. Smith may retain a copy. The copy is held until the original is returned by the man to whom it was given. This copy serves as a check and a reminder for the superintendent, who looks over the lot occasionally to see that no job is being slighted.



THE SUPERINTENDENT WRITES ALL ORDERS ON A SERIALLY NUMBERED FORM, KEEPING A DUPLICATE UNTIL THE ORIGINAL IS RETURNED SAYING THE JOB IS COMPLETED

Purchases Steel Foundry

The Interstate Foundry Co., 3161 E. 61st street, Cleveland, has purchased the Standard Steel Castings Co., 3311 W. 73rd street, Cleveland, according to F. B. Whitlock, vice president and general manager of the Interstate company, who also is president of the Standard company. The purchasing company has acquired the assets and assumed the liabilities of the other. The action of the directors of both companies has been ratified by the respective groups of stockholders. A meeting will be held shortly at which there probably will be some changes in the executive staff. The present plant turning out steel castings and Interstate officers will continue until then. For the present the output of both companies will continue as in the past, the Interstate foundry producing gray iron and semisteel castings and the Standard's Cleveland the Illinois plant motor truck wheels.

Consolidate Interests

The Hausfeld Co., and the Campbell Bros. Mfg. Co., Harrison, O., have consolidated their business interests, and will operate under the name of the Campbell-Hausfeld Co., effective July 1, and will continue to manufacture melting furnaces, and other foundry specialties as well as the Campbell corn, cotton and peanut planters. F. B. Hausfeld, is president, A. M. Campbell, vice president; Jos. E. Hausfeld, treasurer; C. E. Haddock, secretary; H. O. Campbell, purchasing agent, and J. S. Armour, sales manager.

FORMULAS FOR THE BRASS FOUNDRYMAN

RECENTLY PATENTED NONFERROUS ALLOYS

Aluminum-Manganese Bronze

The addition of manganese to aluminum bronze has been the subject of patents in most civilized countries. In Austria, F. Teltscher was awarded a patent on the following alloy:

	Per Cent
Copper	88.16
Aluminum	10.00
Manganese	1.20
Zinc	0.64
	100.00

Imitation Silver

Alloys having a silvery appearance afford a fertile field for inventors. The following example was patented in Great Britain recently by C. E. Monkhouse and M. H. Denton:

	Per Cent
Copper	69.50
Nickel	15.00
Zinc	8.50
Tin	4.50
Lead	2.50
	100.00

Another alloy which looks like silver, and is said to have the added value of being "noncorrosive," and which takes a high polish was patented by C. L. Jones in United States patent No. 1244742. The alloy follows:

	Per Cent
Nickel	67.80
Copper	28.00
Manganese	2.50
Iron	1.50
Vanadium	0.02

Another noncorrosive alloy is the following. It is to be used for electrical contacts. The alloy which is expensive follows:

	Per Cent
Platinum	45.00
Silver	25.00
Gold	15.00
Copper	15.00
	100.00

The patent is United States No. 1101534 and the patentee R. B. Graf.

FORMULAS FOR THE BRASS FOUNDRYMAN

RECENTLY PATENTED NONFERROUS ALLOYS

Manganese Bronze

A method of making manganese bronze using a special hardener was patented in Great Britain by F. Heusler and the British Mining & Metal Co. The specifications cover an alloy containing from 15 to 20 per cent manganese; 5 to 15 per cent aluminum, and small quantities of lead, tin, nickel, cobalt chromium and other metals. The following alloy is preferred for the hardener:

	Per Cent
Copper	63.00
Manganese	25.00
Aluminum	10.00
Iron	2.00
	100.00

The manganese bronze is made as follows:

	Per Cent
Copper	54.00
Hardener	6.00
Zinc	40.00
	100.00

The finished manganese bronze would have approximately the following analysis:

	Per Cent
Copper	57.78
Zinc	40.00
Manganese	1.50
Aluminum	0.60
Iron	0.12
	100.00

In making the alloy it would be necessary to allow about 1.5 per cent excess zinc to compensate for volatilization, also in remelting further additions would have to be made. The manganese, aluminum and iron would be diminished by oxidation in making the alloy.

The above patent also specifies an alloy for bearings. In this alloy the manganese bronze hardener is used as a deoxidizer. The bearing alloy follows:

	Per Cent
Copper	83.00
Tin	9.00
Zinc	6.00
Hardener	2.00
	100.00

Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note book form.

THE FOUNDRY DATA SHEET, JULY 15, 1920

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

Presents Theory on Oxygen Cutting

Cast Iron Has Resisted the Application of Oxygen Welding and Cutting Processes —A Consideration of Metallurgical Properties Points to Physical Causes

BY F. J. NAPOLITAN

FROM the ease with which wrought iron is cut, it may be concluded that an aggregate of ferrite combines with oxygen with greatest avidity, and permits propagation of a cut with least interruption. As the carbon content is increased, there is a material change in the nature of the metal. In place of the preponderance of ferrite grains, the formation of cementite is recognized and its union with some of the ferrite to form pearlite—the original mass of pro-eutectoid ferrite rapidly diminishing in prominence. As anticipated from the nature of pearlite, no material change is noticed in the performance of these alloys under the cutting torch. Of course, an ultra-precise consumption test probably would indicate a lowering efficiency coefficient, but from all appearances, no unusual difficulty is experienced in cutting carbon steels up to about 80 to 90 point carbon. However, a definite transition is indicated here by a distinct laboring of the cutting torch. While the torch will begin a cut with practically the same effort, and proceeds to completion without interruption or unusual delay, yet the kerf is wide and ragged and undeniably distinguished from that of a mild steel cut. It is recognized practice, now, to preheat the piece to be cut to a black or dull read heat, when the impediment, whatever it was, seems to have been entirely eliminated.

Metallography explains the sudden change of properties in the steel. As the carbon content of the hyper-eutectic steel was increased, the proximate mass of pearlite increased, and the pro-eutectoid ferrite correspondingly diminished in volume, until eventually, a point was reached where all of the cementite and ferrite existed in the stratified or laminated relationship of pearlite. This state is recognized as existing where the carbon content is between 80 and 90 point—the approximate analysis of pearlite is yet undefined. As the carbon content is further increased, there appears a constituent known as pro-eutectoid cementite—in fancy, the cementite which has been ejected from the pearlite growth. It is circumstantial that the presence of this pro-eutectoid cementite is directly responsible for the increasing difficulty of cutting. Why did preheating the steel before cutting make such a remarkable difference in the results? To be sure, the rise in temperature might affect the stability of any martensite, troostite, or even sorbite that might have existed, but the temperature was too far removed from the Ac_{321} point to affect the characteristics of the pearlite.

MOST of us have expressed at some time or other the solemn opinion that cast iron could not be cut, because the oxide of iron melted at a temperature higher than cast iron itself. Not only does cast iron burn to form an oxide, but the higher melting point of the oxide probably assists the reaction. While we are rather skeptical of the commercial value of a cast iron cutting torch, and are convinced that, financially, we will never be repaid for the expense of our experiments, yet there are undoubtedly occasions when the cutting of cast iron would be of great value.—Stuart Plumley.

Surely the pro-eutectoid cementite was unchanged—and it was this same constituent that was blamed for the difficulty.

Again, as the carbon content is substantially increased, an equivalent interference with cutting is apparent, until, when the carbon content approaches 2.5 per cent, cutting becomes so labored as practically to cease, and no amount of preheating short of incipient fusion will permit it to proceed. The metal now is termed *cast iron*, and a micro-analysis indicates that in addition to the presence of a certain amount of pearlite and pro-eutectoid cementite, as well as certain foreign and unobtrusive substances, the presence of the final and most stable state of carbon, graphite, is recognized. The pearlite constituent exercises a favorable influence upon the cutting operation and the pro-eutectoid cementite, while it impedes cutting, is readily compensated by a slight preheating. However, the graphite presents an entirely new problem.

One of the stereotyped explanations of why cast iron cannot be cut, that the melting point of the slag is appreciably higher than the melting point of cast iron, is a fallacy. A micro-analysis of the structure of an average cast iron of about 3 to 4 per cent carbon—would indicate a structure identical with that of a hypothetical steel of the same carbon content, except that some of the carbon seems to have been precipitated as graphite. Should that identical pour of cast iron have been cast against a cold iron mold, or otherwise chilled, the carbon would not have been precipitated as graphite and the metal would have been called a *chilled cast iron,* or a *white cast iron.* It would actually have been a hyper-eutectic steel. Such alloys are not uncommon in commerce, and the fact that operators have been able to cut them with no extraordinary effort, has been responsible for innumerable false claims that cast iron has been cut. Unfortunately, the nomenclature of steels and irons is not clearly defined, and undoubtedly, a chilled cast iron is but an extension of the hyper-eutectic series. The melting point of an iron-carbon alloy is a constant of its composition, whether, in the solid state, the metal exists as a typical cast iron or as a steel. Long before the point of fusion, the carbon and the iron exist in one relationship, that of austenite. The conditions affecting the pouring of cast iron determine the final state of its constituents, and it is possible to produce a gray cast iron or a chilled white cast iron, the carbon as graphite or the carbon as in cementite. In either event, the melting points of the resulting products would be identical. Chilled cast iron can be cut with comparative ease, notwithstanding that its melting point is lower than the melting point of the slag produced. It is evident, then, that the melting point of slag is not responsible for the difficulty encountered in cutting cast iron.

While the existence of pro-eutectoid cementite appreciably retarded cutting, the presence of but a comparatively small amount of graphite completely *prevented* cutting. The phenomenon, if it were

Abstracted from a paper presented at a recent meeting of the American Welding society. The author, F. J. Napolitan, is connected with the engineering and research department, Davis-Bournonville Co., Jersey City, N. J.

true, is unique, for it would pre-suppose the incombustilibity of carbon. Science contradicts this immediately. The reaction accompanying the removal of carbon from automotive cylinders by the oxygen method and the explosive combustion of carbon in ordinary gunpowder are proof to the contrary. The conclusion is evident that far from retarding the combustion of the steel matrix, the graphite of cast iron should actually assist it.

The writer investigated further to determine how much graphite influenced cutting. Specimens of so-called malleable castings of the characteristic *black heart* structure were obtained. Such a structure is made in this country by the annealing of white cast iron in which all of the carbon exists in cementite or pearlite, the latter in some cases entirely removed. The treatment decomposes the cementite to precipitate the carbon in minute particles, differing from the graphite of gray cast iron in their extreme subdivision and uniform distribution throughout a ferrite matrix. In making a black heart casting, an oxidizing packing is used so that while the core is that of a black heart casting, the mass near to the surfaces is ferrite. This shell of ferrite was removed so that the materials indicated, under the microscope, a uniform aggregate of ferrite and temper carbon. By preheating this piece to a dull red heat, it was cut with the characteristics of a high carbon steel. This satisfactorily proved that carbon as such did not prevent cutting, but that the physical state of that carbon was responsible. As plates of graphite, cutting was prevented—but as finely divided particles, cutting was scarcely impeded.

Reconsidering previous observations in the light of this development, we began to substantiate our first logical hypothesis. We found, to summarize, that ferrite permitted the metal to be cut most readily. Pearlite with pro-eutectoid ferrite did not materially affect the conditions. A completely eutectic composition first suggested a transitory stage. The existence of pro-eutectoid cementite retarded cutting; but preheating of the piece to a red heat readjusted the conditions so that cutting was again as efficient as in the case of ferrite. As the comparatively low temperature produced by preheating was insufficient to effect any change in the physical state of the constituents of the alloy, it must be concluded that the addition of heat units affected a definite constant, which we assumed was the heat of combustion of the iron, as the two forces were of like characteristics. Then a constant result from a variable, made axiomatic the existence of a second variable.

The second variable, then, it was concluded, was the cooling effect of the stream of cutting oxygen, and a further thought suggested a third variable in the time of chemical reaction between the iron and oxygen. The preheating flames ignited the steel, the cutting oxygen produced combustion, and the propagation of the cut was a natural consequence. However, as the carbon content was increased, the speed of the reaction was materially lowered; but the velocity of cutting oxygen to insure a continuity of oxygen and slag to the bottom of the cut, was a constant. Eventually, a point was reached where the rate of combustion between the iron and oxygen was so slow that the heat units liberated from the reaction were dissipated to such an extent as no longer to ignite adjacent masses of metal—and cutting ceased. By preheating the piece before cutting, we added to the forces on the weakening side of the equilibrium, and cutting once more obtained. The heat units so obtained, compensated for the relatively less heat units liberated from the chemical combination of the iron and oxygen in a definite unit of time.

While the pearlite and pro-eutectoid cementite are readily compensated, the graphite carbon effectively prevents cutting by the ordinary means. No addition of heat units short of incipient fusion, by preheating the object, restores the equilibrium. It was impossible to strengthen further, one side of the equilibrium, but no attempt had been made to affect the other side. We had made no effort to reduce the cooling effect of the cutting oxygen. Therefore, experiments in this direction demonstrated that we could so effectively preheat the cutting oxygen that we could restore the equilibrium without preheating the object.

Shot Iron for Use in Sash Weight Castings

Question: Please advise the best manner of using shot iron in the cupola. We have plenty of stove scrap and are of the opinion that if the stove scrap was charged first it would prevent the shot iron from falling through. We propose making sash weights from such a mix. What amount would you recommend for charging a cupola lined to 42 inches; how much coke between charges and how much limestone? Would there be any difference in the amount of beehive and by-product coke used for melting and does the former require a stronger blast than the latter?

Answer: There is considerable misapprehension in regard to the use of shot iron and small scrap from the cupola drop. When melted it is just as good as any other iron. The theory that shot iron works its way through the charge and is carried through the tap hole into the ladle and later into the casting will hardly bear investigation. It might happen but is highly improbable. The small hard lumps occasionally found in castings are due to entirely different causes which it is not necessary to discuss at present. The fact that such nodules of iron sometimes are found in castings poured from the best of pig iron and carefully selected scrap entirely disproves the shot iron theory. You will be perfectly safe in using shot iron and stove plate scrap in any proportion you please.

A cupola lined to 42 inches will melt satisfactorily on any charge from 1000 to 4000 pounds. The smaller the charge the hotter the iron. For the class of work which you propose to handle, which does not require hot iron, and taking into consideration the bulky nature of stove plate scrap, a 3000-pound charge should give the best results. Use 300 pounds of coke between the charges of iron and about 60 pounds of limestone. After running off a few heats you can vary these proportions a little either way. All coke and all limestone are not alike and it is impossible to lay down a hard and fast rule that will suit all localities.

The amount of coke on the bed will depend on the height of the tuyeres. Place enough coke on the bed so that when it has burned through and settled it will be about 20 inches above the tuyeres, then add 6 inches more of coke and proceed to charge the iron. The cupola should be filled to the charging door before starting the blower.

There is no appreciable difference between by-product and beehive coke when used in the cupola. Your cupola will melt about 8½ tons an hour and therefore you will need a blower capable of delivering about 5000 cubic feet of air a minute.

Purchases Truck Plant

The Yale & Towne Mfg. Co., Stamford, Conn., recently has purchased the Industrial Electric Truck division of the C. W. Hunt company, Staten Island, N. Y. Arrangements have been completed for increasing the company's manufacturing facilities at Stamford to care for the requirements of the new line.

The Diamond Oil Co., Philadelphia, recently has completed additions to its Philadelphia works, including the installation of machinery for treating linseed oil for cores.

New Annealing Oven Saves Heat

Continuous Tunnel Kiln Having Double Chambers With a Common Wall Between Reduces Radiation Surface—Cold Cars Enter One Chamber And Absorb Heat of Cars Coming From Opposite Chamber

SCARCITY of fuel of all descriptions is causing manufacturers to endeavor to conserve as much as possible and to seek more efficient methods of heating. The same problem was met in Europe years ago, but the procedure followed there did not at the time appeal to producers in this country where the fuel supply was plentiful. One of the steps taken to conserve fuel was the use of the tunnel kiln in place of the periodic oven for annealing malleable iron castings. The tunnel kiln permits the charge to be heated on entering at one end of a long tunnel and to be passed to the combustion zone in the direction opposite to that in which the hot gases of combustion are passing. The charge is carried on through the firing zone, usually by cars running on a track through the furnace, and then through a zone which is not heated but which is a part of the kiln and absorbs the heat from the charge as it cools. This method conserves fuel by extracting heat from the escaping gases and using it to heat the incoming charge. Also, tunnel kilns usually have less radiating space in the roof and walls than the several periodic ovens required to accomplish the same amount of work.

Continuous tunnel-type furnaces first were used in the porcelain industry. Later they were introduced for annealing steel and more recently for annealing malleable iron. Until lately all the tunnel kilns installed in this country have been of the type originated in Europe. However, recently an American firm, the General Combustion Co., Chicago, has designed a tunnel kiln embodying new principles.

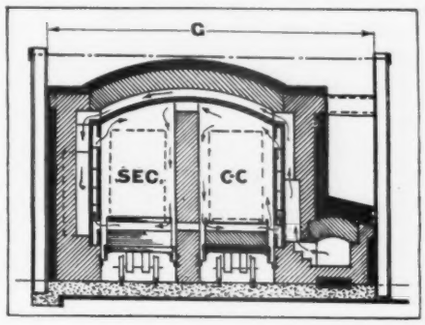


FIG. 1—CROSS SECTION THROUGH FIRING ZONE

This is installed in an eastern establishment and is used for annealing sheet steel. The temperature requirements of this operation are quite rigid to assure the requisite quality and the tunnel kiln has turned out a finished product which is entirely satisfactory.

The kiln of the General Combustion Co. is built under the Kirk patents. The novel feature is that the kiln is composed of two chambers built beside each other with one wall common to both. A plan of one of these units is shown in Fig. 2. The stock progresses through the two chambers in opposite directions, and in each one it moves opposite to the direction in which the burned gases are moving. This regulation is accomplished by having the two firing zones placed diagonally opposite to each other, as may be noted. A wall separates the flues of these two compartments. Fig. 1 shows a cross section of the kiln through the combustion chamber, the arrows marking the direction of travel of the gases. It will be noted that these products of combustion travel directly across the axis of the kiln instead of parallel to it. A number of combustion chambers are provided. The burned gases pass through a flue along the entire length of the wall of the furnace and preheat the incoming air to be used for combustion. This air passes along the same chamber through a line of cast iron pipe of special design.

The entrance end of one chamber is beside the exit end of the other chamber and the wall between is perforated at the top and at the bot-

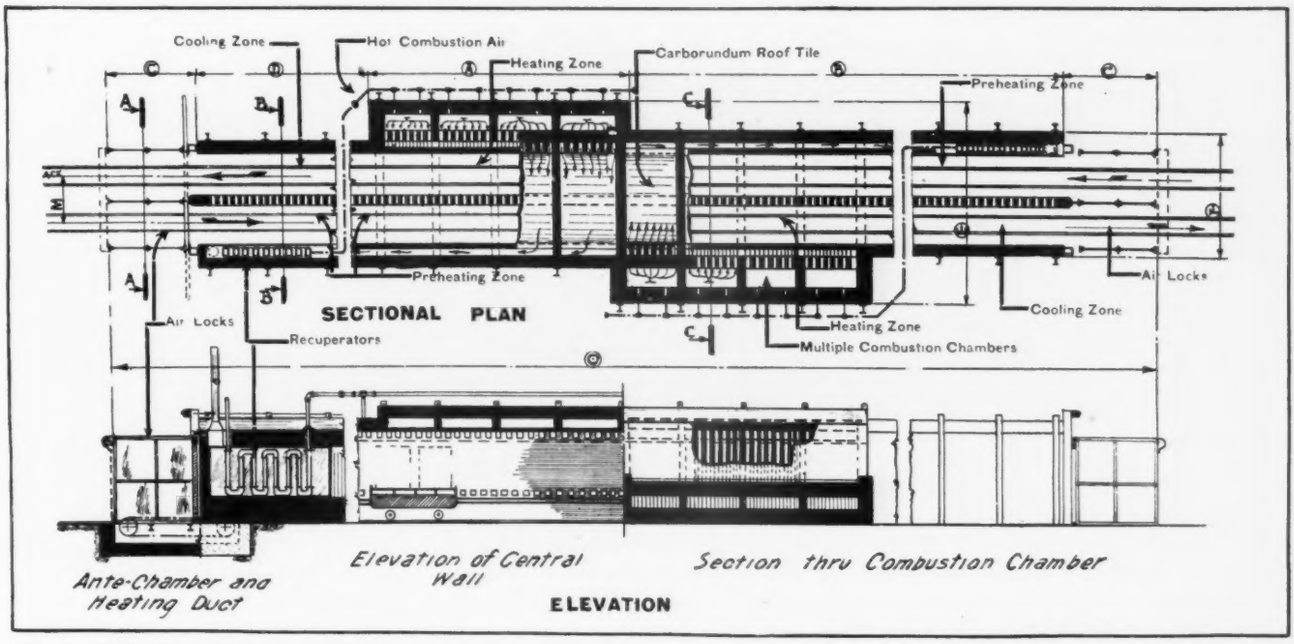


FIG. 2—SECTIONAL PLAN AND ELEVATION OF A DOUBLE CHAMBERED CAR TYPE TUNNEL KILN FOR ANNEALING MALLEABLE IRON CASTINGS—NOTE THE FIRING ZONES OF THE TWO CHAMBERS ARE LOCATED DIAGONALLY OPPOSITE EACH OTHER

tom with a row of ports. With this arrangement the hot air from the annealed pots rises and passes through the upper ports to the chamber containing the cold incoming pots. Being cooled by these the air settles to the bottom portion of the chamber and is drawn through the ports at the bottom of the center wall to the chamber containing the hot pots. In this way the hot material assists in heating the cool incoming charges and these in turn increase the cooling rate of the pots containing the annealed castings.

The kiln is almost a perfect muffle and the charge is never subjected to the direct action of the flame. Little heat is allowed to penetrate underneath the cars, which have an effective seal between them and the walls Therefore no elaborate method for cooling the bearings is necessary.

Antichambers are used at both ends to prevent air from entering the kiln when cars are charged or discharged.

The application of this kiln to annealing malleable iron is shown in Fig. 3, which illustrates the layout of an annealing room with two 40-ton continuous tunnel kilns. The actual

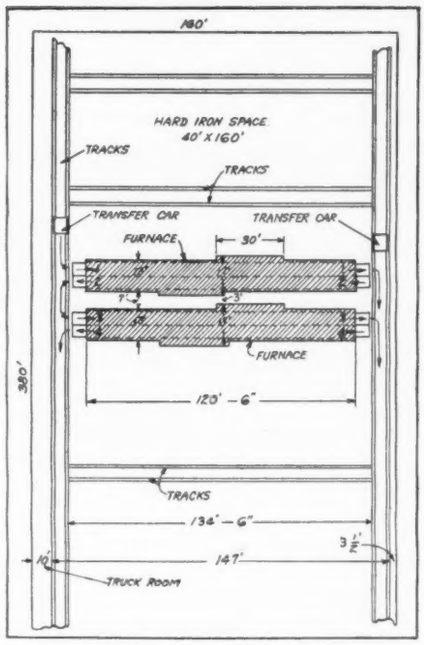


FIG. 3—LAYOUT OF ANNEALING ROOM FOR A MALLEABLE PLANT

length of this double furnace is 120 feet 6 inches, but it is stated that it will anneal as many castings as a single tunnel kiln 241 feet long. To anneal 80 tons of castings a day in a 6¼-day time cycle, with a 6-foot car carrying 6¼ tons of castings, 12.8 cars must be charged 6¼ days before any come out. As the cars are 6 feet long the length of the oven would necessarily be 6 x 6¼ x 12.8, or 480 feet long. Therefore, a single tunnel kiln would require a building considerably more than 480 feet long. A more convenient arrangement is said to be the use of two double type kilns as illustrated in Fig. 3.

In the case under consideration, the two furnaces are placed across one end of the building, adjoining the hard-iron room, leaving ample space for transfer tracks and, with all accessories, occupying not more than 40 feet of the length of the building. Each furnace with its air lock is 134 feet long. The depressed tracks, with transfer cars at each end of the furnaces provide convenient means for handling the cars from the hard-iron room to the kiln, and from the kiln to the dumping floor. Ample space is left for cleaning, sorting, storing and shipping. A 10-foot passage is left for access by industrial trucks to and from the hard-iron cleaning room.

Some Reasons Why Coupling Boxes Break

BY M. E. DUGGAN

AN ARTICLE appeared in a recent issue of THE FOUNDRY illustrating and describing a rolling mill coupling of a new design. The writer of the article refers to the troubles experienced in rolling mill work on account of the couplings breaking after being in service only a few days, and then describes how these difficulties were overcome by a series of experiments supplemented by a study of the conditions under which these castings operate. Some of the experiences of the present writer may be appropriate in this respect since they bear out the value of the policy advocated in the article referred to in THE FOUNDRY. A coupling was designed similar to the one shown in THE FOUNDRY with the exception that one more feature that adds to its worth for the purpose for which it is intended was adopted. This is in the shape of an oil groove which insures constant lubrication on the inside of the box.

Experience gained from observation and study in the rolling mill has shown that in the majority of cases it is not defective material in the casting that causes the trouble. In nearly every case where spindles or coupling boxes break shortly after being put in use, the fault can be traced to incorrect design. Where the boxes do not fit snugly there is excessive back-lash and, if for want of lubrication the boxes do not adjust themselves quickly and readily when the mill is reversed, the pads on the ends of the spindles exert a wedging strain on the coupling boxes and break them. The only way to discover the cause of trouble of this kind and devise a remedy is to study the piece of machinery under actual operating conditions.

About 30 years ago the writer was employed in a mill in the East where 30, 60 and 90-foot rails were rolled. The couplings and spindles in use at that time were the same as those used now. They were known as four leaf clover, or four tooth drive, and a large stock was always kept on hand to replace those which broke, a phenomenon which was even more common then than now.

A new coupling box was designed along lines suggested by a close study of operating conditions in the mill. When the pattern was made and delivered to the foundry, the molding and coremaking was closely watched and after the castings were poured and shaken out they were cleaned so the spindle fitted evenly and closely in the coupling box and all sliding or contact surfaces were free from sand and as smooth as it was possible to make them. Before assembling the couplings and spindles in the roll train the contact surfaces were well greased and they were thoroughly greased every morning thereafter. The grease was applied where it was needed and not in the roll-pit, or all over the roll-housings as is sometimes the case in such work.

This test pair of spindles and couplings ran continuously for four months and a half with no further attention than the daily greasing. A second pair was given the same attention and placed in another mill; they also ran for four months. By the time a third set was installed the novelty had worn off, they were given a scratch brush foundry finish and placed in the mill. They lasted just two weeks. A fourth set was treated with even less care and they lasted just eight hours. The man responsible for cleaning the castings and the greaser were shown the cause of the breakage and after that there was no more trouble experienced from coupling boxes breaking before they had given normal service.

Electrical Melting of Alloys---X

Comparisons Between Types as to Economy Should be Based Upon Identical Operating Conditions—Considerations Which Influence a Choice of Furnace Are Outlined

BY H. W. GILLETT

SOME of the advertising, and even the technical literature of electric brass furnaces includes detailed cost figures to show the relative costs of melting by fuel and by electricity, in which the item of interest and depreciation on the electric furnaces costing from $10,000 to $20,000 each, has been neglected.

For example, take the figures given on a Baily furnace, in the second reference cited, which are reproduced in Table I. At 15 per cent interest, depreciation and obsolescence per year, 1¼ per cent per month, the extra investment of some $7500 more in the electric equipment over the crucible furnaces, or $93.75 per month, at the production in this case of 70 tons per month, amounts to $1.34 per ton, enough to reduce the calculated saving by nearly one-third. If the extra metal loss in crucibles had been only 2½ per cent, the calculated value of the loss would fall $2.40. Had power cost 1.61 cents instead of 1.41 cents per kilowatt hour, it would have cost $1.15 more per ton. By such an alteration of conditions even as bearing only on these two items and the inclusion of interest, the balance would be 39 cents per ton against the electric furnace. Had the furnace been operated another heat per day, the power consumption might have fallen to 500 kilowatt hours per ton on the yellow brass melted, which would again swing the balance for the electric furnace. Or, since the metal loss is not all zinc, but partly copper, one might calculate it to be 1/3 copper at 18 cents and 2/3 zinc at 8 cents, making the value of the lost metal 11 1/3 cents per pound, so that a 4 per cent saving in the electric would be $9.07 and one of 2½ per cent would be $5.67. Another plant might show widely different figures on the coke-fired crucible cost, while still another would use clay lined ladles instead of crucibles for pouring from the electric furnace. That is, slight changes in conditions from plant to plant, in cost of power, metal, crucibles, fuel and labor will often swing the balance back and forth.

In another comparison* of coke-fired, Schwartz oil furnaces and Detroit electrics, apparently on alloys of the red brass type, the labor cost per ton in coke fires is put at 170 per cent of the figure taken in the comparison previously cited, the ladle cost is given as 20 cents against $3.20, power is taken at 1.6 cents instead of 1.4 cents, interest and depreciation are included and lost metal is valued at 18 cents per pound.

This latter comparison is made on the melting of nine different alloys, whose composition is not given, seven different ones being melted in the pit fires; four, including one not given in the coke run, in the Schwartz; and one, not melted in either of the other furnaces, in the electric. The average pouring temperature from the electric was 2280 degrees Fahr. and 2096 degrees Fahr. from the Schwartz. While such records show the cost of melting in each furnace under the conditions which each worked, a comparison of furnaces melting different alloys, heated to different temperatures, is not accurate as to true comparative power and fuel costs and probably decidedly inaccurate as to comparative metal losses. Such tests can be made, if properly taken, to give exact comparative figures on melting costs in any one plant, at any one period, and for any given alloy; but it is asking too much of the laws of chance that they would ever be exactly true for any other plant, other period or other alloy. Relative cost figures are useful, but only for the particular condition upon which they are based. The first essential for a comparison is *accurate* data on the various items of melting cost in the fuel-fired furnaces, and then equally accurate data on various electric furnaces. If a plant can use a large electric furnace 24 hours a day and has moderately cheap power, there usually is so great a lee-way in favor of electric melting that even rough figures will prove it, but as the usable size of electric furnace becomes smaller, the hours operated per day fewer, and the cost of power higher, each case may approach the border line and be highly debatable. The big plant usually has a sure money saver in the right electric furnace for its work, while the little plant had better investigate before it invests. The big plant with a one-ton furnace, costing $12,000 installed,

More Information Needed

ELECTRIC furnace melting as applied to the brass casting industry still is too young to assert positively what constitutes the best practice or what unit takes the lead in economy and efficiency. In the accompanying article, the author emphasizes strongly that accurate data are essential to a comparison between furnaces and that all the contributing factors must be parallel. Relatively minute details may swing the scale for or against equipment which is on trial. A case occurred in a western foundry, where it was found impossible to pour bronze castings from the furnace tightly closed. Ingots accordingly were made from scrap and remelted in crucibles before successful castings were produced. On advice of the furnace makers, a brick was removed from the door, when it was found possible to pour good castings directly without remelting. The small detail mentioned represented the dividing point between success and failure for the furnace. As the author states, "What is vitally needed now is specific information on the abilities of each type furnace for particular tasks." Electric melting furnaces are on trial. Careful study and an exchange of experiences is vital to the success of the industry. The brass founders of the country should not return a verdict until all the evidence is in..

*Compare Collins, E. F., Electric Furnace for Melting Non-ferrous Metals, Foundry, Vol. 47, 1919, p. 329.
Anon, Electric Melting Shows Economy, Foundry, Vol. 47., 1919, p. 848.
And for criticisms of such cost figures, see
Editorial, Electric Furnace Progress, Metal Industry, Vol. 17, 1919, p. 320.
St. John, H. M., Melting Non-ferrous Metals and their Alloys in the Electric Furnace, Chem. and Met. Eng., Vol. 22, 1920, p. 149.

*Reardon, W. J., Electric Melting in an Oil Furnace, Metal Industry, Vol. 18, 1920, p. 208.

producing say 250 tons per month on two-shift operation at 300 kilowatt hours per ton and power at 1¼ cents per kilowatt hour might charge off 60 cents per ton interest and depreciation, and its power cost would be $3.75 per ton. A little one, with a 250-pound furnace costing around $4000 installed, producing 20 tons per month on single shift, at 475 kilowatt hours per ton, power at 2¼ cents per kilowatt hour, would have $3.00 per ton interest and depreciation charge and $9.60 per ton power cost. It would cost the small foundry $8.25 per ton more to melt electrically than it would the large one. Yet the little fellow might be melting with fuel almost as cheaply as his larger competitor. The largest sized furnace that can be kept busy, is the most efficient, in a given type.

Another point to remember, is that the power consumption and production figures quoted by a furnace maker are often those obtained under the best operating conditions, or at least under test conditions, rather than under operating handicaps. This is perfectly just, provided it is made clear what the conditions for those figures are, since to do otherwise would be charging the furnace with avoidable inefficiency of operation.

Makers statements as to metal losses on a given alloy usually can be taken at close to par, because with reasonable care in keeping the furnaces tightly closed, and with the exercise of some common sense in fitting the type of furnace to the alloys to be melted, low metal losses will be the rule in all the furnaces. The uncertainty as to the actual metal losses in the fuel-fired furnaces, due to lack of adequate records, often makes it hard to tell just how much metal electric melting does save.

The choice of a furnace of the proper type for the work to be done should be the result of the consideration of the several factors, as follows:

Present melting cost or possible cost in improved fuel-fired furnaces.
Nature of the work.
Alloys to be melted.
Daily tonnage desired.
Hours per day furnace can be operated.
Characteristics of electric power supply.
Cost of power.
Data at hand to show behavior of different furnaces under corresponding conditions.
Special conditions, such as floor space available, possibility of preheating charge, of mechanical charging etc.

There are some cases where one may at once reject the possibility of electric melting in any type of furnace for the present. A jobbing pattern shop that makes its own castings for brass patterns once a month, could not stand the initial investment in an electric furnace, no matter how desirable its use might be on other considerations. Similarly, the small foundry, where work is intermittent, and where brass or bronze is not melted every day, is not likely to be able to use an electric furnace, although the Ajax-Northrup may ultimately be made cheap enough to meet this requirement. Conversely, the larger the production and the more continuous the operation, the greater is the need for electric melting.

There are probably a few cases where such extremely hot metal is required that no hearth-type furnace with double pouring, will serve. For these, lift-out crucible furnaces still may be required, unless the bull is taken by the horns and a small electric furnace advanced which may be picked up and brought bodily to the molds, or, and far more likely, the molds are brought to the furnace.

Where some cost factor in fuel-fired melting is vanishingly small, it may happen that electric melting could hardly compete.

Natural Conditions Govern

For example, one firm, situated in a natural gas field, has its own gas well on its own property. It is probable that this firm properly will continue to use gas-fired furnaces. The converse of this, equally rare, already has been noted in the use of an electric furnace for intermittent service by a firm having available large amounts of hydro-electric power at practically no cost so that the expense for furnace is practically negligible. The writer's own experimental work on electric furnaces of various sorts has been done under similar conditions, since Cornell university, which is co-operating with the bureau of mines, has a hydro-electric plant which runs whether the electric furnace is operating or not. Therefore the use of power for the furnace involves no cost whatever outside of depreciation.

A more common case where electric furnaces are not applicable is that in which the only available source of electric power, say the central station of a small town, is already heavily loaded and the demand for more power is not yet great enough to justify expansion of the central station. In such a case it normally is not justifiable for the foundry to install or enlarge its own power plant to produce power for the furnaces, as the total investment and the operating costs of a small power plant are too great. Quite similar is the case where a small central station has so much lighting load that it has little surplus for industrial power, and the prices for such power are prohibitive.

Expanding Service

Now that electric melting has cut the shackles of the wrought brass industry by making it possible to melt in decent sized units instead of the absurdly small units to which the fragility of large crucibles formerly held it, it is reasonable to expect that the brass industry will go at its problem on a larger scale, almost comparable to the steel industry. Instead of casting 200-pound ingots and cropping a pipe from each, why not cast a 1000-pound ingot and saw it up to size, thus avoiding the waste in crop ends? Is it not possible also to build and operate brass rolling mill machinery that will handle billets, slabs, etc., considerably larger than the present sizes? The writer realizes that there are many reasons why this has not been done, but now that one of the main reasons has been removed it would appear that some further advances in labor saving and decreased production costs could be made by handling larger pieces. If the writer's idea on this is correct, a 1-ton or larger furnace may have an advantage over a 600-pound size in later operations than melting. However, by the time this is worked out, the preformance of a 1500 or 2000-pound induction furnace doubtless will be thoroughly known and its special problems solved, so the induction furnace bids fair to maintain its present supremacy in the rolling mill industry.

In the smelting and refining industry, the task of taking foul miscellaneous junk and making it into high grade ingot, or direct into castings, is facilitated by a large furnace. Such plants normally can operate 24 hours a day and any

Table I

Melting Cost Per Ton

CRUCIBLES		ELECTRIC	
Coke	$3.80	Power 575 K. W. H. per ton at 1.41c	$8.20
Crucibles	4.60	Crucibles for pouring	2.40
Labor	3.20	Preheating crucibles	.80
Metal loss over electric (4% Zn at 8c)*	6.40	Labor	1.60
Upkeep	.20	Upkeep	.60
	$18.20		$13.60

*Metal loss, coke, 5%; electric, 1%.

A calculated saving of $4.60.

large electric furnace so operated will save metal enough and show a low enough power consumption to beat fuel-fired furnaces.

These plants usually handle a wide variety of alloys and seldom can use the induction furnace unless they are certain of steady work on yellow metal, nor can they normally use a direct arc or stationary indirect arc type, because of the need for melting yellow brass now and then. The moving type indirect arc stands out as the most generally applicable for such service. Since melting is the main operation in such plants it pays to bend every effort toward the reduction of melting costs, and the efficiency of the type mentioned, together with its ability for large production, recommend it. In melting nickel alloys, monel metal for example, which contain no volatile metal and are closely allied to iron and steel, the direct arc furnace has proved its value and is the natural first choice when such alloys alone are melted. True bronze, and possibly pure copper (always with the proviso that we avoid copper poisoning by fumes) are possibilities, for the direct arc type. Where only red brass or bronze are to be handled, with now and then some cupro-nickle or monel on the one hand, and alloys of not over 15 per cent zinc on the other, the stationary indirect arc furnaces deserve consideration. The choice of the indirect arc furnace for cupro-nickel, bronze and the large scale melts of silver, by the mint, was very suitable. The ordinary jobbing shop, changing from one alloy to another in all ranges of zinc content, and normally operating but eight to 10 hours per day, must choose among the versatile furnaces.

If the power conditions prevent the use of a single-phase furnace, the General Electric or Ajax-Northrup would be the choice, as they are the most fully developed polyphase furnaces. Single-phase furnaces are usually admissible, and the jobbing shops are so far using mainly the Detroit and Booth rocking and rotating furnaces, and the Baily granular resistor furnace.

An inattentive or careless operator probably can do more damage to the moving furnace than to the Baily. Where close temperature control and thorough mixing is required or desirable, the former type has an advantage. Where the power supply cannot stand a single-phase 300 kilowatt arc load, but can a 100 kilowatt resistor load, the Baily has a type which will answer. Where high production per furnace is called for, the moving type is ahead. Where melting is but a slight part of the total manufacturing cost the Baily simplicity of operation may overbalance its higher power consumption. Where melting is a big factor in the cost, or where power costs are high (say over 1 1/3 cents per kilowatt hour) the greater thermal efficiency and lower power consumption of the moving type notably overbalances the cost of electrodes and the other factors and swings the scale toward the latter.

Another consideration in favor of the more efficient types of furnace, such as the induction, the high-frequency, and the moving furnaces over the less efficient types, is that the former usually require no more B.t.u. as coal to be shipped to the central station than as coke or oil shipped to the foundry and burned direct in a fuel-fired furnace. The war showed that conservation and efficiency are not merely abstract problems for the next generation, and heatless days, coal strikes, railroad strikes, embargoes, etc., have shown that the more we curtail our requirements for coal production and transportation, the better. Electric brass furnaces effect conservation by saving metal, and by releasing fuel oil for other commercial needs, for shipping and agricultural use.

It is significant that one steel foundry which formerly used a Heroult steel furnace, the standard furnace for its purpose, sold it and replaced it by an open-hearth when the cost of power rose to nearly 2 cents per kilowatt hour.* While the electric furnace gave a higher quality of product, the open-hearth gives a satisfactory quality at a lower cost in this particular case, the cost of power being the deciding factor in the total cost.

Electric melting still is too young for all the needed data on all types and sizes

Table II

Metallurgical Fitness of Different Types

TYPE OF ALLOY									TYPE OF FURNACE						
Chromium	Nickel	Copper	Tin	Lead	Zinc	Mercury	Aluminum	Iron	Direct Arc	Stationary Indirect arc	Moving Indirect arc	Granular Resistor	Smothered arc Reflected heat	Induction Vertical Ring	Northrup High Frequency
15	85								OK	?(1)	?(1)	?(1)	?(1)	?	OK?
	67	28						5	OK	OK	OK(1)	?(1)	?(1)	?	OK?
	25	75							OK	OK	OK	(1)	(1)	?	OK?
	5	95							(2)						
		100							?(2)	OK	OK	OK(1)	OK(1)	?	OK?
		90	10												
		88	10		2				OK	OK	OK	OK	OK	?(3)	OK?
		80	10	10											
		76	3	18	3										
		68	4	26	2				OK(5)	OK	OK	OK	OK	No(4)	OK?
		85	5	5	5				No(5)	OK	OK	OK	OK	OK	OK?
		74	4	5	17										
		80			20										
		70			30										
		67		3	30										
		61	1		36				No5	No(5)	OK	OK	OK6	OK	OK?
		65		1	34										
		60			40										
	18				24				No(5)	No(5)	OK(?)	OK(?)	OK(?)	OK(?)	OK(?)
	3				15		85		No(6)	?	OK(?)	OK	OK(?)	?3	OK?
	2				30		68								
	8						92		?	?	OK	OK	OK	?3	OK?
	10					90			?	OK	OK(?)	OK(?)	OK(?)	?3	OK
	10				85		5		No(5)	No(5)	?	OK	?	?	OK?

O.K.=Furnace Metallurgically satisfactory for this alloy.
?=No data.
OK(?)=Probably satisfactory, but no data.
No=Furnace is not satisfactory for this alloy.
(1)=Temperatures probably rather high for good life of refractories ordinarily used.
(2)=Question of copper poisoning by vapor from direct arc furnace not yet solved.
(3)=Induction furnace for this alloy should have a resistor tube of special design—regular design for yellow brass probably not suitable.
(4)=Load too high for good life of lining now used in induction furnace.
(5)=Furnace causes loss of volatile metal in this alloy.

*Editorial article—Melting changes bring lower costs, Foundry, Vol. 48, 1920, p 253.

of furnaces under all conditions to be available. Much information should be forthcoming in the next few years, particularly from those plants which have installed two or more types of electric brass furnaces. It is unfortunate that only small amounts of what little comparative data on performance of two types, makes or sizes of electric brass furnace on the same work have been secured by such plants, are as yet available. Most of the plants which have gone deeply enough into the problem to see the advisability of installing different types for different work do not care to handicap production by running tests of each type on the various classes of work, and what data they have to show that one furnace is more or less desirable for certain work than another is often withheld because the user sees that each type is valuable and he does not like to throw cold water on its use, even though, under his own conditions, another type will do better work. However, what is vitally needed now is specific information on the abilities of each type for particular tasks, and, even more vitally, data on the limitations of each type. For example, there is no available data on nickel brass (German silver).

It is believed that enough has been said in the preceding articles of the series and in this, to show that electric brass furnaces as a class are an epochal improvement in nonferrous technology, and to make it equally clear that there is no such thing as any one *best* electric brass furnace. Every type, and nearly every form and size of each type, has its specific virtues and limitations which fit it for some work and make it less fit for other work.

The proper choice of an electric brass furnace concerns the user, the furnace maker, and the central station. The first is concerned only with his own problem. The second has a reputation to make or to maintain which is more important than an individual sale. The third should take the broadest point of view of all the interested parties, since if electric brass melting is advanced by fitting the furnace to the job rather than by crowding every foundry foot into the same sized furnace shoe, this field, a most attractive one to the central station, will widen more rapidly. The prospective user has a right to expect that the central station can give him unbiased information. The wise central station manager will inform himself fully and impartially in order to be able to give such advice.

The foundryman should get all the help he can from central station men and from furnace salesmen, but he should let neither attempt to influence him toward a particular type, make or size of furnace on merely general grounds. Each foundry is a particular case and demands its own comparative cost sheets with each item backed up by facts. The furnace salesman usually can prove what the power consumption and metal loss will be for his electric furnace. It is equally necessary that the foundryman know, and not guess, the fuel consumption and metal loss in the fuel-fired furnaces with which he is comparing it.

How and Why in Brass Founding

By Charles Vickers

Adding Deoxidizers in Melting Brass

We have three brass mixtures to make, regarding which we would like to obtain information with especial reference to the order in which the white metals should be added, whether before or after the deoxidizers. The alloys follow: Copper, 85 parts; tin, 5 parts; 5 per cent phosphor tin, 5 parts; lead, 5 parts. Copper, 73.5 parts; 15 per cent phosphor copper, 7 parts; tin, 12 parts; lead, 7.5 parts. Copper, 85.5 parts; 30 per cent manganese copper, 5 parts; tin, 11 parts.

The best time to add the deoxidizing alloys is after the copper is thoroughly molten and quite hot, and before the other metals. In this manner it does its work of purification much better than otherwise. Add the phosphor tin or the phosphor copper to the alloy first, alloy a couple of minutes for the process of deoxidation, then make the other additions.

Manganese copper is used in the same manner as phosphor copper as far as the time of addition goes. It is more important, though, that it be added before the white metals. The use of this deoxidizer is limited to about 0.5 per cent. More than this amount brings on casting difficulties, as the alloy rolls, instead of running into the mold. As it rolls it folds in a brown, tenacious skin of oxide which ruins the castings. Five parts of manganese copper is too much, and it will be necessary to add a small percentage of aluminum to run the metal. If 0.5 per cent manganese copper is intended, this amount can be added and a good casting metal will result. The alloy with 7 per cent phosphor copper is a difficult casting alloy and large castings should be made in baked molds coated with plumbago wash.

Brass for Pressure Bearing

We would like to obtain a mixture suitable for bearings and brasses subjected to considerable pressure as well as severe jolting which breaks many kinds of alloys. Also, would the same metal be satisfactory for slides subjected to pressure?

The following alloy is suggested: Copper, 88 per cent; tin, 8 per cent; lead, 4 per cent. About 0.25 per cent of phosphor copper may be added as a deoxidizer. For the slides add 10 per cent tin, instead of 8 per cent, and reduce the copper 2 per cent.

Overcomes Shrinkage by Change of Gating

We are making some small funnel-shaped castings and experience considerable trouble from defects in the heavier part of the castings. These defects cannot be detected until the castings are machined, as they are underneath the skin. The metal is a good grade of yellow brass, but similar defects also appear in red brass castings. The defects do not appear to be due to porosity as they exist as isolated cavities which, in the yellow brass, resemble worm holes in wood, but, in the red brass, exist as specks. We enclose samples of castings for your inspection.

The defects are due to shrinkage. In the absence of any definite knowledge, we will assume the castings are molded with the large or funnel end towards the cope; that the funnel cavity is partly formed by a cone-shaped green-sand core carried in the cope, as that would be the easiest way to make them. The funnel part is massive and remains liquid after the stem has largely solidified. The stem is then fed by the funnel which acts as a riser to insure solidity of the stem, at the ex-

pense of the funnel. The usual method of gating such castings in brass foundries, is to place a small, rectangular runner in the drag, between two rows of the castings, and to connect the latter to the runner by small gates. Under such circumstances, after filling the mold, the runner and gates solidify first unless close to the sprue. Then the castings must feed themselves. In the rough they may appear good, but if much machine work has to be done on them, shrinkage cavities are uncovered, and the loss runs high. This appears to fit the present case. The remedy is to place another runner on top of the one in the drag. Use a loose wooden runner and lift it in the cope. Make it 7/8 inches high, 3/4 inches wide at the bottom, and 3/8 inches wide at the top, thus having plenty of taper. If this runner fails to entirely stop the trouble, enlarge the gates also.

Seeking Trouble Sources in Brass Castings

We have had trouble lately from pin holes in the brass castings we are making, and would like your advice. These pin holes show up after the casting is machined, and we have tried everything we can think of to overcome the difficulty. We are using the best ingot copper with Straits tin and pure lead in these mixtures, and in melting keep the crucibles well coked, and the metal covered with charcoal and glass. In addition we have tried new sand for the molds, and new annealed crucibles for melting.

We also operate an iron foundry, but we guard carefully against iron contamination of the brass, as we use a different sand for the bronze and separate equipment such as riddles, etc. The cupola is approximately 50 feet from the brass furnaces, and the brass grinding room is separate from the iron grinding room. As a flux for the brass we use rock salt. We shall appreciate any suggestions you may offer.

In this case it appears that everything is being done that skill can suggest to avoid the appearance of the pin holes, but as the pin holes are in evidence it will be obvious there is a break in the defense somewhere. This break must be found, and as it is a most important matter, we suggest that one of the workers be relieved of all other duties, and given the job of discovering the cause of these pin holes. It must be kept in mind that there is nothing mysterious about the matter; something is wrong somewhere, and it should be the business of the one appointed to find out just what it is. We will offer a few suggestions to guide him as follows: Every operation connected with the making of these castings must be analyzed, never mind if it has been done before or not, have it done again, and have the results checked over. Begin with the metal weighing; follow every stage of the melting, and keep a written record of the work. It will be strange if, under these circumstances, a solution of the difficulty is not soon found.

It will be well to know the cause of such pin holes; the most fruitful cause is aeration of the metal while it is melting, and this aeration can occur even though the metal is well covered with charcoal and glass. Charcoal and glass protect the metal, only when it is fluid, but after it reaches a red heat the metal can absorb both oxygen and sulphur, the two elements that cause the holes. Therefore, the metal should be protected before it is melted, as well as after. It is a great help if deepeners are used on top of the crucibles; a deepener is an old crucible with the bottom chopped off with a hatchet. Set the deepener on top of the pot after it is coked up. Put no coke around the deepener. Use it as a hopper to contain the ingots or gates that might stick up above the top of the crucible, if the latter was charged without a deepener. Put one or two small blocks of hard wood in with the ingots as the gases given off by the wood help to protect the copper. When burnt, the blocks form charcoal. A little salt also assists. Try and get all the charge into the crucible and deepener when cold, then melt without having to add cold metal to that already liquid. If gates form part of the charge, put the brass in first, copper on top. The brass will then melt and form a bath in the bottom of the crucible, and this liquid metal will bite off the bottoms of the copper ingots, and cause them to come down more quickly. The solid metal must be aided in sinking down in the crucible, it must never be allowed to wilt down of its own accord. To this end, it should be poked down at intervals, because once it is melted it is completely covered from the furnace gases by the floating charcoal and the other flux substances used. After it is melted it should be thoroughly stirred. Then the tin, zinc and lead added, and stirred and heated until ready to pour into the molds. The addition of a little deoxidizer will do no harm. Add 1½ ounces of phosphor copper to each 100 pounds of metal. Place the phosphor copper in the bottom of the crucible and melt the metal on top of it. See that all these precautions are actually carried out. The only way in which a chemist can assist is in making analyses of the coke for sulphur. The trouble may be due to using a high sulphur coke. This will do no harm if the sulphur can be kept out of the metal, but once there it finds oxygen with which to combine and thus makes the gas sulphur dioxide, which aerates the metal. Again, the sulphur may burn in the furnace to sulphur dioxide, and the copper will absorb this gas if it can come into contact with it, and thus produce porous castings. Of course, there are other causes of porous castings. Thus wet or hard rammed sand will cause porosity, and the holes will be found usually in the cope side. Hot sand also will cause porosity; molds must not be made with a backing of hot sand as it will steam through into the mold cavity. If the molds are skin-dried use no coremaking binders of any kind as a spray to harden the surface of the mold. Even molasses, containing sulphur dioxide, is doubtful. We believe that attention to the suggestions we have made will uncover the cause of the difficulty with pin holes in the case of these castings.

Casting Steering Wheels of Aluminum

We desire information regarding what is known as No. 12 aluminum. This alloy consists of copper 8 per cent and aluminum 92 per cent, and we would like to learn if there is a better alloy available for making aluminum steering wheel centers for automobiles. We experience considerable trouble on account of this alloy's tendency to shrink where heavy spots occur in the castings. We have overcome this by using chills, but as these require time for setting, we have wondered if some other mixture could not be substituted that would not require these chills.

The No. 12 aluminum is the best mixture to use for these spiders, provided it is sufficiently strong for the purpose. It is doubtful if any alloy could be substituted to avoid the use of chills to control shrinkage. The only relief there is from the use of chills is to employ risers, but these are more trouble than the chills. In connection with the casting of aluminum there is one point founders are likely to overlook. Aluminum is approximately one third the weight of brass and, therefore, it is necessary to raise the height of the pouring head over what would be satisfactory in the case of brass, otherwise, the required pressure is not put on the casting, and shrinks and other troubles are encountered. The pouring head for aluminum should be approximately three times that used for brass and if this rule was followed more generally, there would be fewer losses from shrinkage and other difficulties.

Self-Propelled Trucks Reduce Costs

Ease of Operation and Adaptability of This Type of Vehicle Makes It Particularly Well Suited for Use In and Around a Foundry for Intraplant Haulage—Numerous Uses Suggested

BY R. J. WEAN

THE installation of laboratory and other auxiliary equipment to reduce melting losses and to cut production costs has been steadily gaining favor among foundry executives in recent years. However, there is one factor, the cost of labor and the transportation of materials which has a direct bearing on the total cost of the manufactured product which is not recieving the wide spread recognition which its importance seems to warrant. With the exception of the more modern continuous foundries, wheel barrows and cumbersome hand trucks still are employed to convey material around the foundry and from one department to another.

Under present industrial conditions, high cost of labor and extremely high labor turnover, foundry executives will find it worth their while to make a serious study of material handling and transportation problems. The development of industrial transportation equipment has been comparatively recent and only a relatively small number of industrial executives have had opportunity to study its application to their particular problems. The size of a plant and the existing conditions will determine the type of equipment most appropriate.

Many applications will suggest themselves to the ingenious owner of a self-propelled truck and a general outline of some of the more obvious uses to which it is adapted follows:

Handling raw materials; Sand, coke limestone, pig iron and scrap.

Materials in progress; Cores, coremakers and molders daily supplies, flasks, to and from storage, patterns, to and from storage and molten metal.

Finished product; Castings from floor to cleaning department, from cleaning department to shipping room and from shipping room to cars.

Reclaimed material; Gates, scrap and defective castings.

Waste material; Cupola drop to dump, burnt sand and sand blast refuse to dump.

Operated at Low Cost

The cost of handling sand stored in an overhead bin and loaded in a V-dump body erected on a storage battery truck as shown in the illustration Fig. 1, is surprisingly low. Even if the sand is loaded by hand upon the same style truck a material labor saving over the usual wheelbarrow method may be effected. The usual capacity of one of these trucks is 1½ yards of sand, or approximately 15 wheelbarrow loads.

Foundries in which the amount of sand handled is not sufficient to keep a unit of this kind busy could find employment for a lift truck with V-dump skids. After the truck delivers sand it can be used elsewhere either as a flat burden bearing truck or in conjunction with skid platforms.

Pig iron and scrap are loaded into box skids by magnet or other means and transported by lift truck to the cupola charging platform where the material can be charged mechanically if necessary. Aside from the labor saving feature, this system of loading and transporting the cupola charge eliminates to a great extent the hazard to hands and feet when the same work is done by manual labor.

Coke and limestone are handled in the same way as pig iron with the

FIG. 1—DUMP TRUCKS ARE EASY TO LOAD FROM AN OVERHEAD BIN. FIG. 2—THE LIFT TRUCK CAN BE OPERATED IN NARROW AISLES AND AROUND CORNERS QUITE READILY AND ELEVATES ITS LOAD TO A HEIGHT OF SEVERAL FEET

exception that larger boxes are necessary. The trucks are built to carry a certain weight and it is advisable to load them to capacity.

Lift trucks may be used to advantage in the core room. The work benches can be arranged to better advantage because the distance from the oven makes no material difference. Racks for loading the cores may be left at any convenient point and when loaded they can be picked up by the truck and conveyed into the oven. After the cores are dried they are taken out of the oven by the same truck and either carried to the stock room or taken directly into the foundry for the molder's use. It never should be necessary for the molders or coremakers to go to the store room for supplies. Arrangements easily may be made for delivering all store room supplies by truck. This will eliminate wasted time and extra labor.

Increases Yard Space..

The interior of a foundry should not be used as a storage place for flasks and bottom board. Capital invested in a foundry is intended for the purpose of producing a marketable commodity. The percentage of return on the investment is in proportion to the percentage of capacity employed for productive work. When flasks are carried to and from the yard or storage entirely by hand or by wheelbarrow the labor cost is very high. With a lift truck these flasks and boards may be handled on skids and piled as high as desired with a corresponding reduction in the labor cost and an increase in the available yard space. This idea may be carried still further. Skid loads may be tiered so that any part of the pile can be withdrawn without disturbing the loads on other shelves and brought into the foundry without any rehandling. This, of course, would only apply where they would be required at frequent intervals, otherwise a large supply of skids would be tied up.

Patterns may be handled in the same manner as flasks. Instead of allowing a large number of patterns to accumulate in the foundry, a regular schedule can be made whereby a truck that has been engaged in other work all day can make one or more trips between the pattern storage and foundry the last thing in the afternoon.

With reasonably good floors and aisles trucks are steadily coming into favor for carrying hot metal from the cupola to the different floors.

(*Concluded on page* 582)

FIG. 3—THE TRACTOR SPOTS THE TRAILER WITH AN EMPTY DUMP BODY AT THE CUPOLA

FIG. 4—AFTER THE TRAILER IS LOADED THE TRACTOR RETURNS AND HAULS IT TO THE DUMP

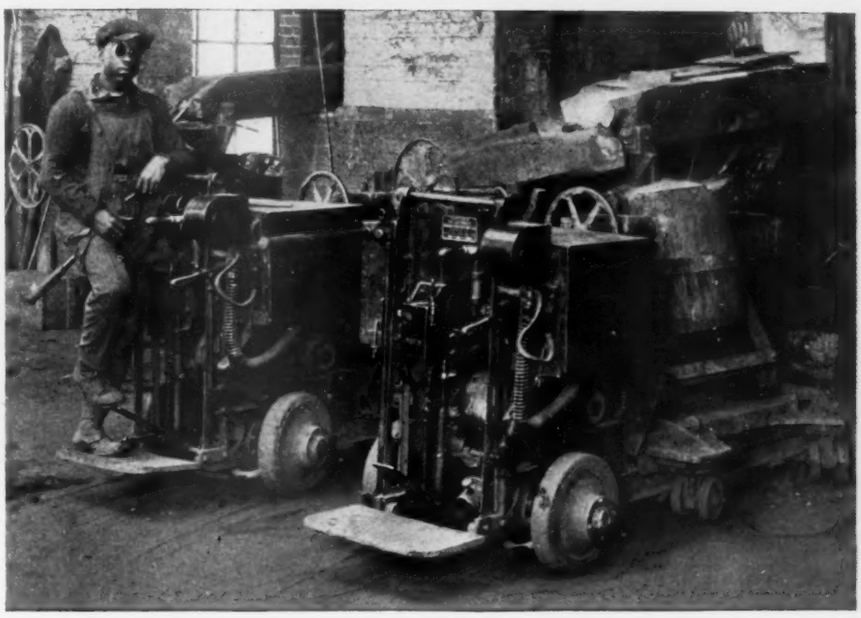


FIG. 5—STORAGE BATTERY TRUCKS ARE EMPLOYED FOR CARRYING THE METAL FROM CUPOLAS

THE FOUNDRY

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Coke Must Be Conserved

ACCORDING to the best informed opinion, there will be a serious shortage of foundry coke within a few months. Shortage of cars, priority orders, railroad strikes and other causes have thrown production so far behind that the coke ovens of the United States will be approximately 25 per cent behind in 1920. The cost of coke is increased each time it is handled, that is loaded or unloaded. For this reason and also because of lack of storage space, the coke companies, so far as possible, load directly from the ovens to railroad cars.

When cars are scarce as they are at present, makers are tempted to allow their ovens to lie idle until a supply of cars seems reasonably assured, or if cars are available, to draw the ovens before the coking process is finished. In either case the foundryman suffers. He receives no coke or he is compelled to accept 20 to 40-hour coke instead of the standard 72-hour product. The most irritating feature from a foundryman's point of view, lies in the fact that he actually needs the coke to take care of increased business and furthermore, although he has the money and is ready to pay a price for which he could have purchased pig iron a few years ago, he cannot get deliveries on his coke orders. In fact, in a great many cases he cannot even *place* his coke orders and must remain constantly on the alert to pick up scattered lots here and there.

There is only one way in which each foundryman may do his part to relieve the situation and incidentally curtail his operating expenses. He can reduce the amount of coke which he has been using. Under ordinary circumstances it might not be necessary to urge conservation, as the added expense of higher price fuel would act as a brake upon extravagance, but when the situation becomes national in character and there are prospects that indicate a 25 per cent reduction in castings output due to lack of fuel, the situation is serious enough to demand earnest and concerted efforts to conserve.

Foundrymen Need Broad Training

ONE of the great needs of the foundry industry is thoroughly trained men. Many large companies have taken the initiative in establishing practical schools where men who are qualified may receive training in the theory and application of foundry principles. Many companies that educate their men in a broad comprehensive manner undoubtedly lose some of them after they become experts. However, such firms secure enough benefits during the time these men remain amply to pay for the troubles taken in training them. The technical features of foundry practice are not so complicated that the workmen cannot hope to attain them. On the contrary, a basic understanding of the general principles involved in molding, coremaking and in mixing and melting iron, readily may be assimilated by the better class of foundry workers, especially the young men who understand the English language. Were technical training offered to every employe at his own volition it would amply pay for the effort. At present there is entirely too great a distinction in many foundries between the so-called practical man and the metallurgist or engineer who is considered in a different class from the man who has worked up from the molder's bench.

Trade Outlook in the Foundry Industry

COKE is the key-log in a jam which threatens to close foundries throughout the east and central west unless relieved within a short time. With only a portion of normal coal shipments reaching the ovens, and with labor shortage and a dearth of cars to transport the product, coke is becoming increasingly difficult to obtain. The stringency in this case is not limited to any one locality nor district, but seems to have fastened a firm grip on all the great producing sources simultaneously. Some foundries have closed while an emergency supply is being sought to tide over operations pending some more lasting relief.

Effect Far Reaching

Those large coke producers which supply blast furnace interests, of course, are favoring their associated companies. One southern by-product plant has served notice upon its foundry customers that it cannot supply any further coke upon contracts during the remainder of the year, unless a radical reverse is encountered and coal can be obtained freely. In explanation, this maker states that with only about 50 per cent of its coal requirements coming to the ovens, the entire output will be required to keep the blast furnaces of its related companies in operation. Iron production also is threatened and a number of furnaces are proceeding on slack blast while some have been banked within the past week. In a few localities where reserve stocks of coke have been exhausted, foundries have closed with no assurance that they may be able to resume soon. Those which are so fortunate as to have several weeks supply in their yards are working on part time schedule and husbanding every resource. Some instances are reported where pea-coke, often mixed with broken debris from the oven linings, and yard scrapings is being sold for $5 or more per ton to foundries which are using this fuel in their mold and core ovens to conserve the foundry coke for their cupolas.

Car Order Pinches

The drastic ruling of the interstate commerce commission limiting open top cars solely to coal transportation has had a far reaching effect. While distinction has been made in some instances which allows coke to be transported, still the spirit of the order has been prejudicial to many transportation needs. Railroads in some cases are accused of stretching a point to serve their own interests in hauling coal, and no reserve which would assure cars when needed at the ovens has been possible. Blast furnaces dependent upon open top cars through their use of loading equipment limited to this class of rolling stock, have been severely handicapped. This factor coupled with the coke shortage have put a number out of blast. Cars of all descriptions to transport northern iron have been lacking, but the southern furnaces have been slightly more fortunate. The latter also have been better able to adapt closed cars to their needs, and foundries have been receiving southern iron recently in box cars, cattle cars, and even refrigerator cars. Transportation difficulties have reacted upon prices both of pig iron and coke for immediate delivery and many plants even though they have these materials contracted have paid premium prices for spot delivery. A tendency has been noted, particularly among larger foundries to contract as far ahead as possible, even in advance of probable needs. A few have purchased iron far ahead of their last half requirements, in the hope of securing delivery upon a portion of this for a reserve against early 1921 needs. In St. Louis, although the nominal price for Connellsville coke has been around $18 ovens, sales have been reported on small lots as high as $25. Despite the discouraging factors encountered during June, pig iron production showed a slight gain. With a total of 3,044,351 tons, June registered an increase of 52,526 tons over May as shown by figures compiled by *The Iron Trade Review*. The June output averaged 101,478 tons per day or an improvement of 4968 tons over the May daily average of 96,510 tons. However, the increase was confined to steel works furnaces, as the merchant stacks lost 880 tons per day during June as compared with May. The daily average for June was 25,209 tons as compared with the May average of 26,089 tons for merchant stacks.

Prices of Raw Materials for Foundry Use

CORRECTED TO JULY 8

Iron		Scrap	
No. 2 Foundry, Valley	$45.20 to 46.20	Heavy melting steel, Valley	$25.00 to 26.00
No. 2 Southern, Birmingham	40.00 to 42.00	Heavy melting steel, Pittsburgh	25.50 to 26.00
No. 2 Foundry, Chicago	44.00 to 45.00	Heavy melting steel, Chicago	23.00 to 23.50
No. 2 Foundry, Philadelphia	46.85 to 49.35	Stove plate, Chicago	31.50 to 32.00
Basic, Valley	45.00	No. 1 cast, Chicago	41.00 to 41.50
Malleable, Chicago	43.50	No. 1 cast, Philadelphia	37.00 to 39.00
Malleable, Buffalo	46.25	No. 1 cast, Birmingham	30.00 to 33.00
		Car wheels, iron, Pittsburgh	38.00 to 39.00
		Car wheels, iron, Chicago	35.50 to 36.00
		Railroad malleable, Chicago	28.75 to 29.25
		Agricultural malleable, Chicago	28.50 to 29.00
Coke			
Connellsville foundry coke	17.50 to 18.50		
Wise county foundry coke	17.00 to 18.00		

Orders Continue

Orders for castings still continue, although many foundries report a slackening off in volume of new business. The automobile and implement trades are strong factors in the castings market, while cast iron pipe, fittings and miscellaneous castings for construction purposes are less actively sought. Early and favorable action is expected on the recommendation of the association formed by railway executives to hasten the grant of a loan of $183,691,508 from the revolving fund of the transportation act for the purchase of new cars and locomotives and for rebuilding and repairing equipment. Within the last week or 10 days private interests and railway companies have placed orders for over 3000 steel cars in the Pittsburgh district, while refrigerator, stock and open top cars have been placed in large numbers in Chicago and vicinity. This buying shortly will bring new business to malleable and steel foundries. Prices of nonferrous metals, based on New York quotations follow: Copper, 18.25c to 18.37½c; lead, 8.50c; tin, 48.50c to 48.75c; antimony, 7.50c to 7.75c; aluminum, No. 12 alloy, producers' price, 32c and open market, 30c to 31c. Zinc is quoted at 7.75c to 7.80c, St. Louis.

Comings and Goings of Foundrymen

DR. GEORGE S. WEBSTER the newly elected president of the American Society for Testing Materials is a Philadelphian. Graduating, in 1875, from the civil engineering school of the University of Pennsylvania located at that city, he became affiliated with the engineering service of Philadelphia and has been connected with the engineering work of that city ever since. Dr. Webster served as chief engineer of the city from 1892 to Jan. 1, 1916, when he was appointed director of wharves, docks and ferries. This position he held until this year when he was reappointed chief engineer. Besides his regular work he also had charge of the bureau of filtration for one year, and for a while was acting transit commissioner for the city. In all these positions Dr. Webster has been in close touch with the testing of materials. One of his achievements in this line was the establishment of a municipal testing laboratory. This laboratory was first used only for cement testing but its scope has been gradually increased until now all materials and supplies used by the city are tested by the laboratory force. Interested in the development of his profession he has been active in a number of societies and is past president of the Philadelphia Engineers club; the Philadelphia association of the American Society of Civil Engineers; and of the Sanitary Engineering section of the American Public Health association. Dr. Webster is at present one of the three representatives of the American Society of Civil Engineers on the engineering division of the National Research council. His alma mater confered on him the degree of Doctor of Science in 1910.

R. W. Scott has been made superintendent of the foundry division, Packard Motor Car Co., Detroit.

S. B. Spalding recently has resigned his position as general manager of the Lansing Foundry Co., Lansing, Mich.

C. C. Peterson has been made foundry manager for the R. Herschel Mfg. Co., Peoria, Ill., which has constructed a large new addition including a gray iron and a malleable foundry.

Harold P. Furlong recently has acquired the interest of Leonard D'Ooge in the partnership of D'Ooge and Furlong Foundry Supplies and Equipment, Detroit. Mr. Furlong has secured a new warehouse which is located at 26 Richmond avenue, Detroit, where he will continue to handle foundry supplies of every character.

Lee W. Van Cleave, of the Buck's Stove & Range Co., St. Louis, was re-elected president of the National Association of Stove Manufacturers at its recent annual convention. Other officers re-elected are: First vice president, Robert M. Leach, Weir Stove Co., Taunton, Mass.; second vice president, B. E. M. McCarthy, Phillips & Buttorff Mfg. Co., Nashville, Tenn.; treasurer, Walter M. Jones, Richmond Stove Co., Richmond, Va.; and secretary, R. S. Wood, 508 National State Bank building, New York City.

DR. GEORGE S. WEBSTER

Charles Gaspar, formerly of the Detroit office, has been made assistant manager of sales of the National Malleable Castings Co., at Cleveland. At one time Mr. Gaspar was in charge of the company's St. Louis office. L. W. DeWitt, formerly of the Chicago sales force, and recently transferred to Washington, succeeds Mr. Gaspar at Detroit, in looking after miscellaneous sales in the Michigan territory. George V. Martin goes to Washington to succeed Mr. DeWitt. Elmer Juergens, purchasing agent at Cleveland for the National company, recently was chosen president of the Cleveland Purchasing Agents' association.

C. F. Drozeski, D. A. Drozeski, and F. T. Kennedy recently have purchased the Franklin Park Foundry Co., Franklin Park, Ill. This plant which is located in a suburb of Chicago includes a malleable foundry with two 12-ton air furnaces having a capacity of approximately 450 tons per month. Connected with this is a gray iron foundry which has an average output of 300 tons per month. The new company which will be known as the Central Malleable Castings Co., expects to start operations about Aug. 1.

Invite Industries to Safety Council

The National Safety council has launched a membership campaign with a two-fold ultimate aim—first, to introduce organized accident prevention work in every plant of more than 100 workmen in all of the industries rated as hazardous by insurance companies and second, to bring to the 7500 plants that are already members of the council the benefit of the accident experience, both good and bad, of every industrial plant in the country having a serious hazard.

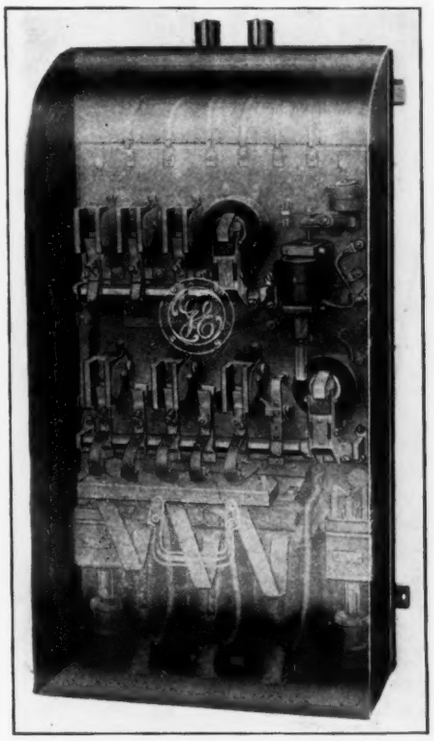
As the first step in this campaign the story of what the council is and what it does together with copies of the *National Safety News* and of the council's bulletin service have been sent to 16,000 plants, including practically every company rated at more than $100,000 in the 15 most hazardous industries not already members of the council. These 15 groups include cement manufacturers, chemical manufacturers, coal mines, construction and building contractors, electric light and gas companies, electric railways, foundries, glass manufacturers, iron and steel mills, large gas companies, meat packers, metal goods manufacturers, paper and pulp manufacturers.

Craig Adair, formerly vice president of Penn Seaboard Steel Corp. and Paul Day of the same corporation, have resigned and have formed the Adair-Day Corp. to handle iron and steel products and mechanical specialties, with offices at 1025 Widener building, Philadelphia.

Automatic Starter for Induction Motors

An automatic starter suitable for use with squirrel cage induction motors when they are driving line shafts, pumps, compressors and similar devices, has been developed by the General Electric Co., Schenectady, N. Y. It may be operated by push button, float switch, pressure governor or other automatic accessory.

When in use the master switch is closed. This closes the 5-pole starting contactor which connects the compensator coils to the line, also the primary leads to taps on the coils, thus reducing the starting voltage.



AUTOMATIC ENCLOSED STARTING MECHANISM FOR MOTORS

The accelerating relay also is connected to the line circuit and operates at the pre-determined current value for which it is set. It opens the circuit to the starting contactor coil and closes the circuit of the 3-pole running contactor coil. This circuit is held closed by a shunt coil.

An interlock on the starting contactor completes the circuit to the line contactor coil when the former opens, thus preventing the closing of the starting contactor before the running contactor has opened. The starting contactor is further provided with a normally open interlock which makes it unnecessary to hold the starting button or other device in during the starting period.

The contactors are provided with magnetic blowouts, moisture proof coils and solid copper contact tips that are easily renewable. Equipment in steel mills, cranes and other heavy duty apparatus that requires continual starting, stopping and reversing of heavily loaded motors has proved that this type will stand up well under severe service.

The compensator winding has two coils for 2-phase motors and three for 3-phase which insures balanced starting currents and maximum starting torque per ampere line current. The taps terminate in an accessible place in front of the compensator coils. The set most suitable for any particular application may readily be selected.

The motor is automatically started by means of this device independent of the operator's judgment. This is accomplished through the accelerating relays or current limit relays which operate the contactors to disconnect the auto-transformer and connect the motor on the line on proper acceleration. Overload protection is furnished by two inverse time element relays which are operative during both starting and running. After an overload they may be reset by means of handles which project through the panel behind.

Make Special Delivery

The Farrell Foundry & Machine Co., Ansonia, Conn., recently, telephoned to the New York office of the Lakewood Engineering Co., Cleveland, requesting the quickest possible delivery of a tractor. It was impossible to await delivery from the factory, so a machine which with its batteries weighed almost two tons, was taken from the show room, loaded upon a dray by means of an elevating platform truck made by the Lakewood company and delivered to a cartage company. Here it was reloaded upon a motor transport truck and taken overland, being delivered and ready for service within 30 hours after the order was placed.

Prepare Motion Pictures

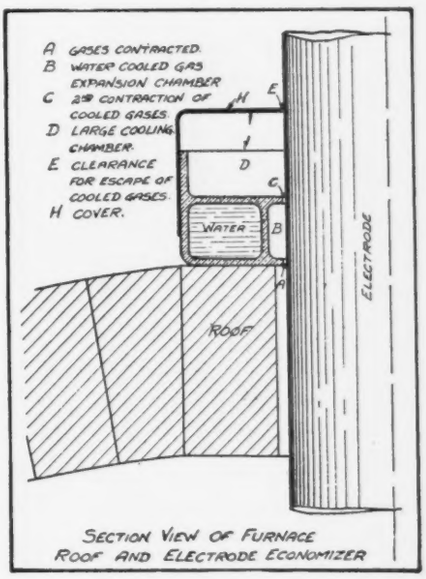
A series of motion pictures has been prepared showing the Sullivan Machinery Co.'s plants in Claremont, N. H., and in Chicago. Interior views of the Claremont foundry show the pouring of air compressor castings. Various processes of manufacture through the stages of machining, assembly and erection are given. Other portions of the film depict manufacture of different mining machinery and the use of this machinery in mines. The films were taken by the Rothacker Film Mfg. Co., Chicago.

Device Cools Gas Around Furnace Electrodes

A device designed to cool the gases below the ignition temperature as they come from the electric furnace through the holes around the electrodes has been developed by the Electric Furnace Construction Co., Philadelphia. When the gases pass out through the economizer, cooled below the ignition temperature, no flame is started and the electrode is not burned as it would be by a flame of ignited gas playing around it.

As shown in the accompanying illustration, the device consists of water cooled rings which fit around the electrode directly above the furnace roof.

While the gases are inside the furnace, they are under reducing conditions,



DETAILS OF ECONOMIZER FOR COOLING GASES FROM ELECTRIC FURNACE

and have, therefore, only their own sensible heat and no heat generated by the oxidation of combustible constituents. These gases first pass in between the electrode and the port hole of the roof, and then through a clearance in the cooling ring and into a relatively larger chamber, which causes the expansion of the gases, thereby giving up a large amount of sensible heat in the gases. This heat is absorbed by the water in the cooling ring. From this chamber they pass through a small clearance, and then enter a very large chamber for a second and much larger expansion. This chamber is surrounded, in the case of graphite electrodes, by a thin enclosed cover, which, in actual practice, has been found quite sufficient to dissipate the heat given up by these gases, and when they finally pass through the temperature is below ignition.

It is stated that on 3 and 6-ton furnaces using graphite electrodes, the

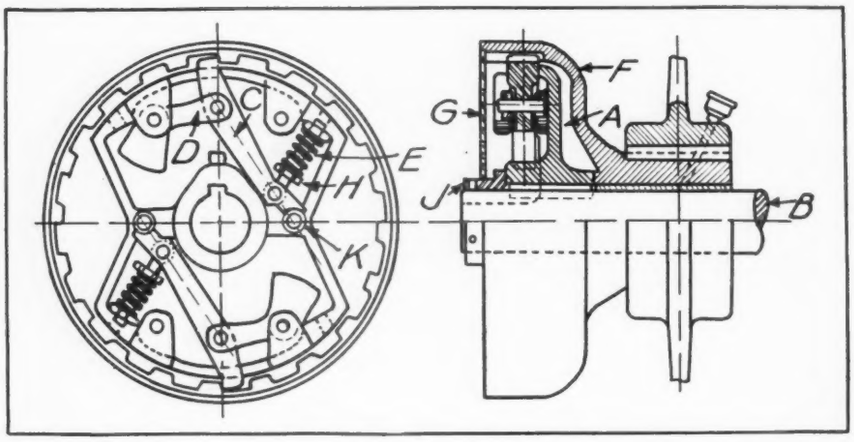


FIG. 1—DIAGRAM OF WORKING PARTS OF AUTOMATIC OVERLOAD RELEASE

electrode consumption has been reduced from an average of 30 pounds to from 10 to 15 pounds per ton on steel by means of the economizer.

Automatically Releases Driving Mechanism

The mechanical device shown in the accompanying illustrations has been developed by the Link-Belt Co., Chicago, to provide a pronounced factor of safety in the operation of elevating, conveying and power transmission machinery. It is designed to disengage the drive instantly when the load exceeds a predetermined point.

The spider *A*, keyed to the shaft *B*, has triggers *C* pivotally mounted on the links *D*, with the ends engaging inside notches in the rim of the drum *F*, and rollers *K*. The springs *E* regulated to any desired pressure by the adjusting

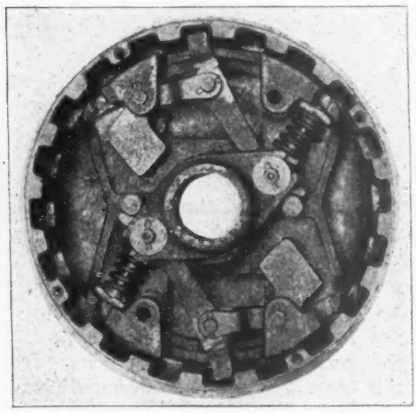


FIG. 2—OVERLOAD RELEASE WITH PARTS IN POSITION FOR DRIVING

nuts *H* hold the ends of the triggers on the rollers *K* under normal conditions. When the drive is over stressed the compression of the springs will permit the ends of the triggers to drop into the position shown in Fig. 2, releasing connection with the rim *F* and allowing the driven machine to stop immediately.

The construction of the device is such that it will release whether the load is gradually or suddenly applied, but it can be set so that it will not trip from a jar or shock. It is symmetrical and can be assembled to operate in either direction. It can be adjusted for tension and

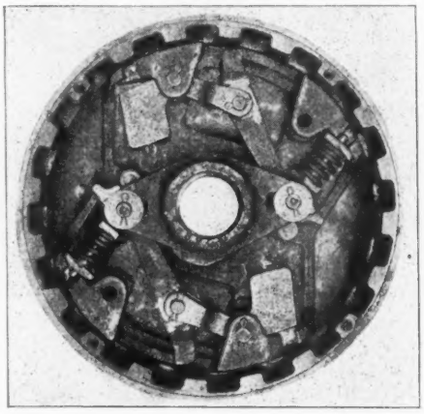


FIG. 3—OVERLOAD RELEASE WITH PARTS IN RELEASED POSITION

set to operate at any desired over load. The mechanism is entirely enclosed and can be packed with grease for lubricating the working parts.

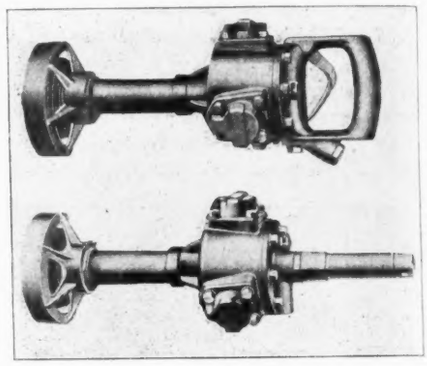
Will Install Second Unit

The McLain-Carter Furnace Co., Goldsmith building, Milwaukee, recently received an order for the installation of a second open-hearth furnace in the plant of the Aetna Steel Casting Co., Lorain, O. This company has been operating a 5-ton furnace of the McLain-Carter type and has made numerous record heats, having melted 5 tons in two hours and 15 minutes.

The Cleveland Co-Operative Stove Co., Cleveland, recently has completed a plant addition which includes an assembly, japanning and pattern shops.

Small Pneumatic Grinders

Small pneumatic grinders recently designed by the Ingersoll-Rand Co., New York, and shown in the accompanying illustration, are light weight, high speed tools running with a free speed of 4200 revolutions per minute. They are suitable for grinding, buffing and polishing various kinds of work. Both of the machines shown



SMALL GRINDERS ARE OPERATED BY SELF-OILING MOTORS

are provided with the same style of motor but are equipped with different types of throttles and handles.

A special feature of these tools is the 3-cylinder motor which constantly runs in a bath of oil, insuring lubrication of all the parts. Lack of proper oiling has been one of the reasons for grinder trouble in the past. The valve is made integral with the crankshaft, simplifying the design. The piston and connecting rods also are uniquely constructed. Ball and roller bearings are used throughout. The removal of a few screws permits the handle to be lifted off and exposes the entire interior mechanism to view for inspection.

Self-Propelled Trucks Reduce Costs

(*Concluded from page* 577)

Ladles of from ½ to 1½ tons capacity are erected on skids provided with rollers so that if necessary they can be pushed by hand. The lift truck may be employed to pick up both skid frame and ladle and carry it to any designated point. The metal is distributed in hand ladles.

After the molds have been dumped the castings can be loaded in metal boxes or on iron bodied trailers. Where the volume of work warrants, a number of trailers will prove economical. Much more material can be moved in a given time because the tractor can pull from five to ten times the tonnage a lift truck could carry in one load.

Castings should be routed from

the casting floor to the car in which they are shipped in as straight a line with as few rehandlings as possible. Lift trucks and skids meet these conditions admirably. By keeping the castings on skids or on trucks they are readily accessible for grinding or for any other operation and can be conveyed to the shipping department when finished. If a lift truck is used, the skid loads may be piled selectively.

The Material Handling Machinery Manufacturers association recently has changed its headquarters from 35 W. 39th street, to 110 W. 40th street, New York. Zenas W. Carter is secretary and manager.

Plan Enlarged Plant

It is stated that present production will be trebled when a series of improvements and additions to their plant at Kenton, O., will have been completed by the Champion Engineering Co., builders of electric traveling cranes at that place. The foundry will be extended and new buildings erected for structural steel fabricating shops; raw material storage; a tool and jig manufacturing plant; a pattern vault and steel foundry. Besides these, a new power plant of sufficient capacity to take care of future power requirements will be built. The present power plant will be retained for emergencies.

The company has inaugurated a building program which includes 50 houses to be constructed immediately, to be followed by others as circumstances warrant. These houses are to be built on a plot in the center of the company's grounds and will be sold to the men on the payment plan. A company hotel which will also serve as a civic center will be built on the same property and will form the main gathering place for employes.

The hotel will at first accommodate 50 people and will be provided with an auditorium 30 x 100 feet, suitable for business meetings, lectures, picture shows and banquets. The basement will be fitted up as a club room with baths, gymnasium, billiard and pool tables and bowling alleys.

What the Foundries Are Doing

Activities of the Iron Steel and Brass Shops

M. D. Drake has purchased the plant of the Hub City Pattern Works, Centralia, Wash.

The plant of the Union Foundry, Rockford, Ill., recently was damaged by fire.

The Landlan Foundry Co., South Haven, Mich., recently purchased a site for a plant.

The plant of the Bennington Foundry Co., Dallas City, Iowa, recently was damaged by fire.

The plant of the Keystone Brass Foundry Co., Pittsburgh, recently was slightly damaged by fire.

Erection of an addition to its plant, to house a foundry and machine shop, is being planned by the Johnson Bronze Co., New Castle, Pa.

Contracts have been awarded by the Onley Foundry Co., Philadelphia, for the erection of an addition to its plant.

B. F. Avery & Sons, Louisville, Ky., have been granted a permit to go ahead with the construction of an addition to their foundry building.

The Louisville Aluminum & Brass Foundry, Louisville, Ky., recently was incorporated by William O. Bonnie Jr., Elmore Sherman and E. E. Kirwan.

Capitalized at $5000, the Ann Arbor Foundry Co., Ann Arbor, Mich., recently was incorporated by Thomas Kooks and others.

The South Haven Foundry & Machine Co., South Haven, Mich., recently increased its capital stock from $25,000 to $50,000.

The Ervin Foundry & Mfg. Co., Adrian, Mich., contemplates the erection of additions to its plant.

Work has been started on the erection of a machine shop and foundry for the Delaware Aluminum Co., Muncie, Ind.

The Interstate Brass Mfg. Co., 11 South Desplaines street, Chicago, plans the erection of a one and two-story plant, 73 x 125 feet.

The Des Moines Foundry & Machine Co., 314 Flynn building, Des Moines, Iowa, is building a foundry and machine shop, 130 x 220 feet.

Plans have been prepared by the National Brake & Electric Co., Milwaukee, for the erection of an addition to its foundry, 166 x 180 feet.

The Portland Foundry Co., Portland, Me., recently was organized with a capital stock of $250,000.

Contracts have been awarded by the Herschel Mfg. Co., Peoria, Ill., for the erection of an addition to its foundry.

The plant of the Central Brass Mfg. Co., 6207 Cedar avenue, Cleveland, recently was damaged by fire.

A. O'Neill, 68 Post street, San Francisco, has plans for the erection of a plant to be equipped as a brass works.

The plant of the John Watson Mfg. Co., Ayr, Ont., manufacturer of agricultural implements, etc., recently was damaged by fire.

The Farrel Foundry & Machine Co., Ansonia, Conn., recently took over the plant of the Seymour Mfg. Co.

Plans have been drawn for J. A. & W. Jolly Co., Holyoke, Mass., for the erection of a new foundry building.

The Brown & Sharpe Mfg. Co., Providence, R. I., expects to have its new foundry in operation some time in August. With new equipment the daily cupola capacity will total more than 100 tons.

The Equipment Mfg. Co.'s new foundry which has been under construction at Conneaut, O., for some time, has been completed and has been placed in operation.

The Atlas Foundry Co., Lyons avenue and Colt street, Irvington, N. J., has had plans prepared for the erection of an addition to its plant, 50 x 75 feet.

Capitalized at $1,000,000, the American Malleable Iron Co. recently was incorporated in Delaware by John Deacree, Clarence A. Southerland and W. G. Singer all of Wilmington.

The Waukesha Malleable Iron Co., Waukesha, Wis., has been leased to the General Motors Corp., according to a recent announcement by C. Haertel, president.

The Northern Brass Foundry, Portland, Oreg., has been organized by W. C. Thom, Robert J. Gray and others, and plans to establish a foundry and repair plant.

Henry Holder Jr., architect, 242 Franklin avenue, Brooklyn, N. Y., is preparing plans for the erection of a foundry, 100 x 250 feet. The name of the owner has been withheld.

The Roos Foundry, Inc., Chicago, recently organized with $500,000 capital, has taken over the plant of the Henry Roos Foundry Co. and plans the erection of additions to the plant.

The W. Robertson Machine & Foundry Co., 58 Reno street, Buffalo, has had plans prepared for the erection of an addition to its plant, 120 x 170 feet.

The Haywood Foundry Co., Indianapolis, recently was incorporated with a capital stock of $15,000, by M. E. Haywood, A. H. Cromley and Harris Farris.

Capitalized at $100,000, the McFadden Foundry & Machine Co., Columbiana, O., recently was incorporated by W. A. Lyder, M. L. McFadden, H. W. Forney, C. Frederick, W. C. McCord and A. F. Poulton.

H. E. Powell, Fannie H. Powell and J. A. Mullins were named as the incorporators of the Sweetwater Machine & Foundry Co., Sweetwater, Tex., which was recently chartered with a capital stock of $10,000.

The Dominion Brass Products, Ltd., Toronto, Ont., has been incorporated to manufacture brass, etc., with a capital stock of $40,000, by Thomas B. Richardson, room 41, 2 Wellington street east, Edward A. H. Martin, 44 Elgin avenue, and others.

The Kelley Foundry & Machine Co., Elkins, W. Va., recently was incorporated with a capital stock of $25,000, by Samual T. Speers, C. H. Hall, S. H. Watring, D. J. Blackwood, J. F. Kelley and J. P. Kelley.

Capitalized at $3,000,000, the Reading Steel Casting Co., New York, recently was incorporated with an active capital stock of $3,000,000, by W. B. Lasherm, W. J. T. Moore and W. T. Morris, 540 Crown avenue, Brooklyn, N. Y.

The Copper Products, Ltd., Montreal, Que., recently was incorporated to manufacture copper, brass, etc., with a capital stock of $3,000,000, by Gordon W. MacDougall, William B. Scott, James A. Mathewson and others.

A recent increase in the capitalization of the Cleveland Co-Operative Stove Co., Cleveland, was made to cover the cost of new buildings and equipment at its plant. The company now has a foundry, 135 x 1000 feet.

A foundry will be built at Columbiana, O., by a company which is being formed by Clyde Hoover, William Shaufer and F. H. Grove. The building will be 100 x 120 feet, and castings for rubber machinery will be the product.

Data, catalogs and information regarding modern foundry equipment are desired by the Owego Foundry & Machine Co., Owego, N. Y. It plans the erection of a frame plant addition, 36 x 78 feet, so

that it can be extended readily to 78 x 108 feet. Pierre Duvinage is proprietor of the company.

To provide additional working capital, the Western Foundry & Mfg. Co., Springfield, O., recently increased its capital stock from $10,000 to $30,000. At present no plant enlargements or equipment purchases are contemplated. Clarence O. Lutz is secretary of the company.

The Kokomo Malleable Iron Co., Kokomo, Ind., has been organized with a capital stock of $350,000 and plans are being prepared for the erection of a malleable plant, the main building to be 85 x 360 feet. The equipment will consist of two 15-ton furnaces with a daily capacity of 36 tons.

The General Motors Corp. has purchased the Doylestown Agricultural Works, Doylestown, Pa. It expects to erect there within two years a large plant for the manufacture of automobiles and farm machinery. The General Motors Corp. will continue the manufacture of farm machinery for export at the present plant.

Increasing its capital stock from $100,000 to $300,000, the American Metal Products Co., Milwaukee, has purchased a 6½-acre site on which it plans to erect a modern foundry, 80 x 220 feet, immediately and later erect a rolling mill for the rolling of rods, strips, sheets, etc.

The Service Casting Co. recently was organized at Blanchester, O., to specialize in the manufacture of small gray iron castings. The foundry has been in operation since last February, doing contract work. Officers of the company include, R. B. Huyett and Charles N. Secrist.

Because of the needs of its greatly increased business, the Lansing Foundry Co., Lansing Mich., recently increased its capital from $150,000 to $350,000. This will enable it to carry larger stocks of raw materials and to accumulate the products it manufactures. Glen L. Orr is secretary and general manager of the company.

Work has started on the erection of the new plant units for the Gilbert & Barker Mfg. Co. Springfield, Mass., which will consist of a 3-story, 63 x 222-foot recreation building; a sheet metal building addition, 164 x 181 feet, a foundry, 80 x 400 feet and various other structures. Actual construction of the buildings has been held up by the scarcity of materials and labor troubles.

The Valley City Machine Works, Grand Rapids, Mich., has increased its capital from $50,000 to $250,000. This increase will be utilized for the purpose of developing a new plant on the site purchased when the company's gray iron foundry was established two years ago. This improvement, however, will not be made for some time. An announcement will be made later regarding necessary equipment, etc.

When its new building is completed the American Machine & Foundry Co., 5520 Second avenue, Brooklyn, N. Y., will employ 2500 workmen. The new 5-story structure will be 100 x 190 feet with a 30 x 50-foot annex. The general contract for the building has been let to the H. D. Best Co., New York. Equipment will consist of cranes, industrial railway, sprinklers, compressed air, monorail system, etc.

The Cuyahoga Foundry Co., Cleveland, which was organized recently was a capital of $200,000, to manufacture gray iron and semisteel castings, is planning to engage in active business shortly. The company has a plant, 109 x 180 feet, equipped with a 10-ton and a 3-ton traveling crane. Officers of the company are: President, John Vild; vice president, Anton Anyz; treasurer, Charles Wachalee and secretary, Frank J. Opatrny.

Work has been started by the Dominion Steel Products, Ltd., Brantford, Ont., on the erection of a new pattern shop, to take care of the increased demand brought about by the recent completion of its gray iron and brass foundry. The foundry is equipped with a 20-ton air furnace used for the manufacture of chilled and cast iron rolls, close grained iron castings, etc. It also has two cupolas with a capacity of 12 tons per hour and an electric brass furnace of 1000 pounds capacity.

The Westport Brass Foundry, Inc., Westport, Conn., recently was organized with a capital stock of $25,000, of which $10,000 has been paid in. The company is building a small plant in order to get into production immediately, hence equipment requirements are small. Later on the company will build a large structure. The building now in course of erection is on the Boston Post road, Westport. Officers of the company are: President, W. A. Selde; treasurer, K. Klein, 1862 Second avenue, New York, and secretary and manager, C. Craig, 179 Wilson street, Bridgeport, Conn.

Assets of the Standard Steel Castings Co., Cleveland and Chicago, have been acquired and its liabilities assumed by the Interstate Foundry Co., Cleveland. This will permit of the expansion and development of the Standard company's business and the consolidation has been ratified by the stockholders of both companies. The Interstate company now is engaged in settling accounts of the Standard organization and F. B. Whitlock, vice president and general manager of the company, has this matter in hand. A complete announcement as to the plans of the company is expected to be issued shortly.

Formed to take over the business recently carried on as a partnership by the Springfield Aluminum Plate & Castings Co., Springfield, O., a company with the same name has been incorporated. While the product heretofore has been confined to a large extent to the making of vibrator pattern plates and aluminum pattern castings, the new organization contemplates production of large work. On July 1 the company moved into new and larger quarters. Officers of the company are: President and general manager, P. A. Parker; secretary and treasurer, W. J. Jordan, and vice president, I. K. Hook. These men with H. S. Simondinger and W. Ream compose the board of directors.

With headquarters at 204 Medford building, Akron, O., the National Furnace & Stove Co. has been organized with a capital stock of $350,000, and plans the erection of a plant at Ravenna, O. The plant will consist of a foundry, 82 x 121 feet, with a capacity of 50 complete furnace casting daily; tin shop and office building, 82 x 100 feet, and other structures. Because of the scarcity of homes the company also plans to erect houses for its employes. Officers of the company are: President and general manager, George Heincke; vice president, C. C. Earnest; secretary-treasurer, H. H. Montis; general sales manager, V. W. Jaeger, and general superintendent, R. W. Mizner. Work on the erection of the plant is expected to be started about Sept. 1.

New Trade Publications

FLEXIBLE HOSE.—Flexible steel hose for industrial work is described in a small booklet recently published by the Sprague Electric Works of the General Electric Co., New York.

RECORDING DEVICE.—The Gisholt Machine Co., Madison, Wis., is circulating a 4-page leaflet in which various points of a recording machine for use in keeping accurate tab of the amount of time on work being performed, are pointed out.

GRINDING WHEELS.—The use of grinding wheels on the Blanchard surface grinding machine is described and illustrated in a 22-page booklet being circulated by the Norton Co., Worcester, Mass. Some interesting data are given.

GRAPHIC INSTRUMENTS.—The Esterline Co., Indianapolis, is circulating a 4-page leaflet entitled, "Graphic Instruments in the Field of Transportation," in which the use of recording instruments on steam and electric railroads is described. A number of charts are given.

ELECTRIC DRILLS AND GRINDERS.—Portable electric drills and grinders, including drills for operation on both alternating and direct current, are described and illustrated in three leaflets issued under one cover by the Standard Electric Tool Co., Cincinnati.

STEEL HOSE.—The Sprague Electric Works of the General Electric Co., New York, has published a 20-page illustrated booklet in which it describes and illustrates flexible steel hose for use in railroad service. Specifications and other data are given.

OXY-ACETYLENE APPARATUS.—Acetylene generators, welding and cutting torches, pressure regulators and portable welding and cutting outfits are described and illustrated in a 16-page booklet, recently published by the Davis-Bournonville Co., Jersey City, N. J.

GAS PRODUCER.—The Wellman-Seaver-Morgan Co., Cleveland, has prepared a 48-page booklet in which its mechanical gas producer is described and illustrated. The booklet contains a number of interesting chapters, including one on operation. Data given includes gas analysis, installation, tables, etc.

HEAVY EQUIPMENT.—The Wellman-Seaver-Morgan Co., Cleveland, has published a series of booklets in which various heavy equipment which it manufactures is described and illustrated. The equipment includes: Hoisting and mining machinery; hydraulic turbines; steel works equipment; coke oven machinery; port and terminal equipment; special cranes; rubber machinery and coal and ore handling machinery. The illustrations show the various equipment at work and line drawings accompany each halftone illustration.

TRUING DIAMONDS.—The Norton Co., Worcester, Mass., has published an illustrated booklet in which commercial diamonds for truing grinding wheels are described. Origin, classification, color, quality, shapes and sizes of the stones and other details are given, including the method of setting and suggestions for their use, etc.

POWER TRANSMISSION.—The Fairbanks Co., New York, has published a cloth-bound book in which various equipment handled by the company's power transmission division, is described and illustrated in a clear and concise way. Tables and specifications, which act as an aid to purchasers in determining their requirements, are given, as well as suggestions for installing the various equipment.

OIL CIRCUIT BREAKERS.—The Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has issued a number of leaflets in which oil circuit breakers are described and illustrated. Both application and distinctive features of the various breakers are discussed. Each leaflet contains a table, giving an outline of maximum current, voltage and interrupting capacity ratings. Some of the circuit breakers described handle voltages as high as 25,000 and are rated as high as 23,000 amperes. They are for indoor service, either manually or electrically operated, with full automatic, nonstop, single throw control.

INDUSTRIAL LIGHTING.—The Copper Hewitt Electric Co., Hoboken, N. J., is circulating a booklet containing a number of illustrations showing industrial lighting installations. The installations include those at the plant of the American Radiator Co., Bayonne, N. J., showing illumination in the naval gun shop; the shell plant of the E. W. Bliss Co., Brooklyn, N. Y.; the ordnance section of Dodge Bros., Detroit; the machine section of the Champion Spark Plug Co., Toledo, O.; the erecting aisle at the plant of the Liberty Machine Tool Co., Hamilton, O.; the main aisle of the plant of the Cincinnati Planer Co., Cincinnati; the screw making machine department of the Pheoll Mfg. Co., Chicago; the tool room of the Cincinnati Milling Machine Co.; the engine testing room of the Willys-Overland Co., Toledo, O.; the assembling department of the Avery Co., Milwaukee, and a number of others including those at motor plants and textile mills.